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A REVISION OF THE FAMILY COLUMBARIIDAE (MOLLUSCA: GASTROPODA)

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Abstract

The family Columbariidae comprises the genera *Columbarium, Fulgurofusus, Coluzea, Serratifusus* gen. nov. (Type species, *Fusus craspedotus* Tate 1888), *Hispidofusus* gen. nov. (Type species, *Fusus senticosus* Tate 1888) and *Histricosceptrum* gen. nov. (Type species *Columbarium atlantis* Clench and Aguayo 1938).

Apart from the genus *Coluzea* all species of these genera are redescribed and one new species of *Hispidofusus*, six new species of *Serratifusus* and two new subspecies of *Columbarium* are described from the Tertiary of Victoria.

The genus *Columbarium* is recorded from the Maestrichtian and Paleocene of Europe, from the Eocene of the southern United States, the Upper Eocene to Recent of Australia and possibly the Paleocene of New Zealand.

Fulgurofusus is recorded from the Paleocene and Eocene of the United States and living in the Atlantic and South Pacific Oceans.

Coluzea is newly recorded from the Middle Eocene of Europe and the south and east coast of southern Africa.

Introduction

The family Columbariidae consists of a small group of about fifty species distributed by the writer in six genera, three of which are new. The origin of the family is obscure, as fossils are rare except in Australia and New Zealand, and those that are available shed little light on the subject. Recent species are widely distributed in the Indo-Pacific area and the West Atlantic but as they are common only in moderately deep water, say 70-400 fathoms, no museum has an extensive collection of them and indeed many species are founded on unique specimens, or at most two or three. In this paper the majority of the described species are re-examined with particular emphasis on the Tertiary species of South-Eastern Australia, to which are added eleven new species or subspecies. As the revision of the family arose from work on the Australian fossils, the New Zealand genus *Coluzea*, which has many living and fossil species, has not been studied in great detail.

Historical Review

The family Columbariidae was erected by Tomlin in 1928 (p. 330) for a single genus *Columbarium* which combined certain features of the radula and aperture of the Muricidae with the form and protoconch of the Fusininae, but with its own characteristic operculum.

Columbarium itself was introduced in 1881 by Martens as a subgenus of *Pleurotoma* for two living species, *Pleurotoma (Columbarium) spinicincta* Martens 1881 from Eastern Australia, and *Fusus pagoda* Lesson 1834 from Japan. Its placement in the Turridae (= Pleurotomidae), on evidence from the radula examined by Schacko (in Martens 1881) was later shown to be erroneous. Two later authors, Watson (1882) and Tate (1888), in describing respectively, living and fossil representatives of Marten's new genus, preferred to describe their species as *Fusus* rather than *Columbarium* because on conchological grounds they would not accept the assignment of their species to the Turridae.

Of the authors of the conchological monographs both Fischer (1883) and Tryon (1884) accepted Martens's placement, though Tryon was not completely satisfied with this assignment, but Cossmann (1896, 1901) preferred to place *Columbarium* with the Fusidae (= Fusininae). In 1901 Martens added a further two species to the genus which he retained in the Turridae (= Pleurotomidae).

In 1922 Peile examined an undoubted radula of *Columbarium pagoda* and found that the genus should not be placed in the toxoglossa i.e. the Turridae, but rather, the rachiglossa near the Muricidae. He suggested (p. 14) that Schacko's original specimen figured as the radula of *C. spinicinctum* was in fact the remains of a crustacean. Three years later (1925) Thiele re-examined Schacko's slide and would not accept that the two isolated objects thereon were radula teeth. He placed the genus in the Muricidae between *Typhis* and *Murex* on the evidence of the operculum and radula.

Subsequent to Tomlin's creation of the family Columbariidae in 1928, Finlay (1930) tentatively placed therein two other genera, *Fulgurofusus*, an American Paleocene genus described by Grabau in 1904 (Type species, *Fusus quercollis* Harris) and *Coluzea*, a New Zealand genus with living and Tertiary representatives, which Finlay himself had erected in 1927. Finlay and Marwick 1937, further discussed the affinity of *Columbarium, Coluzea* and *Fulgurofusus*, and described the first species of the latter to be recorded outside North America, *Fulgurofusus vulneratus* from the Wangaloan stage (Paleocene).

Wenz in 1941 reduced the status of the family to that of a sub-family within the Muricidae and doubtfully accepted Finlay's inclusion of *Coluzea* and *Fulgurofusus.*

Finlay's assessment of the systematic position of *Coluzea* was ultimately shown to be correct by Dell 1956 (p. 47, fig. 49), who found that the radula and operculum of *Coluzea mariae* Powell were characteristic of the family.

Clench's monograph of Atlantic Columbariidae (1944) listed the species known to the author, but some are omitted. Apparently Clench was not aware of Finlay's work, as only the genus *Columbarium* is discussed.

The latest significant contribution to our knowledge of the family is that of Barnard (1959) who examined the radulae and opercula of four of the five South African columbariids and confirmed Tomlin's original definition of the family.

Origins of the Family

The earliest records of columbariids are from the Maestrichtian and Paleocene of Western Europe and the Paleocene of the United States and New Zealand. The earliest species of *Columbarium* at present known makes its appearance in the Maestrichtian of the Netherlands and ranges into the Paleocene of Belgium, Poland and probably New Zealand. A single species is known in the lower Eocene of the southern United States. There are no other fossil records apart from Australia where the genus appears in the Upper Eocene and continues to the present day.

The American genus *Fulgurofusus* appears in the Paleocene and ranges into the Eocene but there is no other fossil record of descendants. However if the writer's interpretation is correct, related species are still living in the Atlantic and off the New Zealand coast. The New Zealand fossil species originally described as *Fulgurofusus vulneratus* Finlay and Marwick is thought by the author to have more affinity with *Columbarium.*

Coluzea appears in the Middle Eocene of the Paris Basin and also occurs in the Lower Oligocene of Germany. There are no other fossils known to the author apart from those of New Zealand, where the genus was established in the Lower Oligocene and continues to the present day. *Serratifusus*, a seemingly related genus and possibly derived from it, known only from SE. Australia, ranges from Lower to Middle Miocene. Another Australian genus with the same range, *Hispidofusus*, exhibits features of both *Serratifusus* and *Columbarium*.

The origin of the African recent columbariids is obscure. There is no known fossil record so it seems likely that they are either recent immigrants from Australia and New Zealand, or that sediments representative of the depths at which they are presently found are not known in the African Tertiary.

The Japanese *Columbarium pagoda* (Lesson) and the New Zealand *C. veridicum* Dell are probably of recent origin derived from Australian stock.

Notes on Stratigraphic Terminology

For the purposes of this paper the stratigraphic correlation and stages as outlined by Ludbrook 1967 have been used, but with the following modification. The Cheltenhamian is retained in its usual position at the top of the Miocene because of the occurrence of the Miocene cephalopod *Aturia* at its type locality.

Recently O. P. Singleton (1967) replaced the stages with a system of molluscan assemblages and these are indicated in the table using Arabic numerals, though the author prefers not to drop the old system of stage classification until some of the assemblages are better known. At our present state of knowledge the stages allow more room for error in correlating the various faunas.

Stratigraphic Distribution of Australian Tertiary Columbariidae

The Eocene and Oligocene columbariids of South-eastern Australia are not of great significance because few outcrops are available, and in some cases only a few individual specimens are known. However, in the Lower Miocene, during conditions of deeper water over large areas of South-eastern Australia, they become widespread and relatively common and reach their zenith in the Middle Miocene. Thereafter, due to the widespread Upper Miocene regression with conditions of shallow water, they become rare and in the Pliocene absent, except for a single broken specimen from the Abbatoirs Bore in South Australia. The following table gives an outline of their stratigraphic and geographical distribution.

Notes on the Systematic Descriptions

The length of the descriptions of all species has been kept to a minimum by omitting repetition of all characters common to the genus and hence found in the generic descriptions. Species descriptions are arranged in order of stratigraphic occurrence.

All measurements are in millimetres and a standard set of measurements have been taken as follows: L, Total length of specimen. LS, Length of specimen excluding canal. HA, Height of aperture measured parallel to the axis of the shell. W, Width of the final whorl from edge to edge of the keel and not including projections such as spines or flanges.

All localities mentioned are in Victoria, Australia unless stated otherwise. The grid references are taken from the standard inch to one mile Australian Military sheets and the name of the appropriate sheet is given before the number of the reference. During this study, the writer has visited and collected columbariids at most localities for which grid references are quoted.

TABLE 1

	Columbarium																Serratifusus		Hispidofusus	
Species / Molluscan Assemblage	C. sp. cf. spinicinctum Martens	C. vulsum subsp. nov.	C. acanthostephes (Tate)	C. echinatum subsp. nov.	C. spinulatum (Cossmann)	C. uniliratum sp. nov.	C. calcaratum sp. nov.	C. cochleatum (Tate)	S. squamulatus sp. nov.	S. stellatus sp. nov.	S. archimedes sp. nov.	S. clydoniatus sp. nov.	S. craspedotus (Tate)	S. foleaceus (Tate)	S. bovarius sp. nov.	S. (?) youngi (Chapman)	S. scabrosus sp. nov.	H. piscatorius sp. nov.	H. senticosus (Tate)	
Blanche Point								X												6
Browns Creek III							?													
A w I							X													8
Bird Rock Lower						X														10
Base, Pt. Addis Lmst.						X														
S. of Birregurra						X														
Table Cape				X	X															11
Fischer's Point Lower																	X			12
Fischer's Point Upper															X			X		13
Curlewis				X											X	X		X		
Belmont															X	X				
Amphitheatre, Leigh R															X	X				
Kennedy's Ck.				X											X	X		X		
S. of Melrose Road.															X			X		
Glenelg R.															X	X		X		
Murray R.					X								X					X		
Fossil Beach			X										X	X					X	16
Grices Cr. upstream			X										X	?					X	
S. of Grices Creek													X	X					X	
Batesford Quarry													X							
Port Campbell Cheese Factory														X					X	
Griffins														X						
Red Hill, Shelford			X										X	X					X	
Dennant Creek		X											X	X						
Native Hut Cr. upstream		X											X	X					X	
Muddy Creek lower		X																	X	
Inverleigh		X										X							X	17
Grices Creek downstream		X							X	X	X	X							X	
Manyung Rocks		X							X	X	X	X								
Western Beach, Geelong		X																		
Murgheboluc		X								X		X								
Timboon		X																		
Lake Bullenmerri		X								X										18
Lake Gnotuk		X								X										
Rutledges Beach		X								X										
Rose Hill	X																			19
Meringa Creek	X																			20
Bunga Creek	X																			

Systematic Descriptions

Superfamily MURICACEA

Family COLUMBARIIDAE Tomlin 1928

Elongate fusiform shells generally prominently keeled and with a siphonal canal longer than the spire. Protoconch deviated, paucispiral. Axial sculpture reduced. Operculum horny, pyriform, narrowing regularly to an acute point with an apical nucleus. Central teeth of radula with a curved plate with three cusps flanked on either side by a single elongate lateral.

STRATIGRAPHIC RANGE: Maestrichtian—Recent.

COMMENTS: Wenz (1941, p. 1085) reduced the status of the family to that of a subfamily within the Muricidae; however, this is not accepted by later authors such as Barnard (1959) or Dell (1956) and is not accepted by the writer. It is true that there are certain features of the columbariids which do approach those of the muricids, for example the radula and the apertural characteristics of *Columbarium*, but the overall morphology of the shell, the nature of the operculum and protoconch suggest relationships with the Fasciolariidae. Also, the group has a long geological history with its origins in the Cretaceous, and is not directly derived from the Muricidae. It seems reasonable, therefore, to give the group family rank within the Muricacea.

Hispidofusus gen. nov.

TYPE SPECIES: *Fusus senticosus* Tate 1888.

ETYMOLOGY: L., *hispidus, a, um*, hairy, prickly; L., *fusus, -i*, spindle; gender masculine.

DESCRIPTION: Shell elongate, fusiform of regularly convex whorls cut by a keel bearing short triangular spikes. Protoconch of two whorls, the first somewhat globose deviated perpendicular to the axis of the shell, the second smooth and differentiated from the spire whorls. Spiral sculpture of first spire whorl in the form of a keel beginning rather abruptly at the end of the protoconch. Adult whorls convex, almost tumid, with numerous prominent lirae bearing well developed spines or scales. Aperture oval with the inner lip covered with a curved plate; outer lip denticulate within. Canal long and only slightly twisted.

STRATIGRAPHIC RANGE: Lower-Middle Miocene.

DISTRIBUTION: South-eastern Australia.

COMMENTS: This genus is intermediate in morphology between *Columbarium* and *Serratifusus*. Its protoconch is intermediate between the two. It has a *Columbarium*-like aperture, but the overall shell morphology is that of *Serratifusus*. However the inner lip has not the prominent almost semicircular plate typical of *Columbarium* but is 'plastered' over with a thick callus. The outer lip of *Columbarium* is not denticulate within. *Serratifusus* on the other hand has two or three ribs on the final protoconch whorl and never has the inner lip covered. Most Australian workers have been content to group the type species of the genus with the other species of *Columbarium* but Harris (1897, p. 133) retained it in the genus *Fusus* because of its typical '*Fusus*' protoconch. Of the species of *Columbarium* it comes closest to the Upper Eocene *C. cochleatum* (Tate) and may well be derived from it, though no connecting forms are known.

The record of *Fusus senticosus* from the Plantagenet beds of Albany by Chapman and Crespin (1934) is based on two external moulds. Until further material is available it is not possible to determine their true affinities.

Hispidofusus piscatorius sp. nov.

(Pl. 2, fig. 2-3, 5; Fig. 16)

DIAGNOSIS: An elongate *Hispidofusus* with convex whorls. Protoconch not greatly differentiated from spire whorls. First spire whorl faintly ribbed. Posterior whorl slope with two lirae bearing small scales. Anterior whorl slope of body whorl with about five prominent scale-bearing lirae, two of which are present on the spire.

DESCRIPTION: Shell elongate, fusiform of convex whorls cut by a prominent keel bearing small triangular spikes. Protoconch globose, smooth, of two whorls, first whorl deviated and, at the end of the second, plicate with a median nodulate keel developing and the protoconch merging abruptly with the spire whorls. First and occasionally the second spire whorls are generally faintly axially ribbed, thence smooth with traces of spiral sculpture developing. Posterior whorl slope with two lirae which bear scales where they are crossed by the growth striae. Anterior whorl slope with about five more prominent lirae which bear larger scales; two of these lirae are also present on the spire. Aperture oval, columella lip covered with a thin curved lamina. Inner side of outer lip furrowed, the furrows corresponding to the lirae. Canal long and straight bearing spinose lirae of which two or three are more prominent.

DIMENSIONS:

Holotype P26453	L 21	LS 18	HA 6	W 9	Canal broken
Paratype P26455	24·5	16	5·5	9	Curlewis

LOCATION OF TYPES: National Museum of Victoria: Holotype P26453, Collected NMV 14/12/1967; Paratype P26455, F. A. Cudmore Collection.

TYPE LOCALITY: Upper Mollusc horizon 70′-80′ above Lake Craven on Fischers Point, Aire R. Grid Ref. Aire 352,163. Fishing Point Marl, upper part. Batesfordian.

STRATIGRAPHIC RANGE: Batesfordian, Lower Miocene.

OCCURRENCE: Type locality.

Gellibrand Clay: Cutting on Princetown-Cobden Rd, 1·2 miles SW. of Melrose Rd, Grid Ref. Princetown 032,348; Cutting on Lavers Hill-Cobden Rd, Kennedys Creek, Grid Ref. Princetown 615, 239.

Curlewis Formation: Curlewis.

Glenelg Group, Myaring beds: Limestone Creek, Glenelg R., Listers Cliff, Glenelg R.

Cadell Marl lens, Morgan Limestone: R. Murray cliffs left bank 4 miles S. of Morgan, S.A.

MATERIAL: Type, and eight specimens.

COMMENTS: This is distinguished from *Hispidofusus senticosus* (Tate) by the ribbed or noduled early whorls which are lacking in the latter, by the protoconch which merges into the spire whorls, by the sculpture of the posterior whorl slope which is not as spinose and has only two rather than three lirae, and by having two spinose lirae on the anterior whorl slope of the spire whorls. The specimens from the R. Murray cliffs connect this species with *H. senticosus* as the protoconch approaches that of the latter, but the overall morphology of the shell is that of *H. piscatorius* sp. nov.

TABLE II

Comparative Table of Genera

	Protoconch	Sculpture	Aperture	Keel
Coluzea	Angular, of 1½-2½ whorls, first whorl deviated at a low angle to the axis of the spire. Differentiated from spire whorls by plicae or abrupt change in shell pattern.	Spiral lirae usually prominent. No scales or spines. Often broad axial ribs.	Inner lip covered with a thin glaze. Outer lip not toothed nor reflexed.	Serrate, rarely produced into a flange.
Serratifusus	Globose, of 1½ whorls, first whorl deviated at about 45° to axis of spire. Differentiated from spire whorls by prominent axial plicae.	Fine to coarse spiral lirae often with scales. No anterior carina. Prominent axial ribs on first two or three spire whorls.	Inner lip covered with a thin glaze. Outer lip not toothed, denticulate within and reflexed.	With short triangular spikes, rarely produced into a flange.
Hispidofusus	Globose, of 2 whorls, first whorl deviated perpendicular to the axis of the spire. Differentiated from spire whorls by incipient ribs or abrupt change in shell pattern.	Prominent spiral lirae with small spines or scales. No anterior carina.	Inner lip covered with a thick plate-like callus. Outer lip not toothed, denticulate and grooved within.	With small, short, triangular spikes.
Columbarium	Globose, of about 1½ whorls, first whorl deviated perpendicular to the axis of the spire. Not differentiated from spire whorls.	Fine to coarse spiral lirae often present. Anterior carina always present on body whorl. Spines or scales often present on lirae. No axial ribs.	Inner lip covered with a prominent curved plate. Outer lip with a tooth at the position of the anterior carina, not denticulated within.	With prominent triangular spikes, rarely produced into a flange or serrate.
Histricosceptrum	Ditto.	Prominent spiral lirae. No spines or scales. No anterior carina.	Inner lip covered with a thin glaze outer lip not toothed nor denticulate within.	With elongate tube-like spines.
Fulgurofusus	Ditto.	Fine spiral lirae or threads. No spines or scales. No anterior carina. No axial ribs.	Ditto.	Serrate or produced into a flange.

Hispidofusus senticosus (Tate 1888)

(Pl. 2, fig. 1, 6-7, 9, 14; Fig. 12)

Fusus senticosus Tate 1888, *Trans. R. Soc. S. Aust.* 10: 135; Pl. 7, fig. 3; Harris 1897, *Catalogue of Tertiary Mollusca* p. 133.

DIAGNOSIS: An elongate *Hispidofusus* with very convex whorls and impressed sutures. Protoconch differentiated from the other whorls. Posterior whorl slope with three spinose lirae. Anterior whorl slope of body whorl with six spinose lirae of which three are present on the spire whorls.

DESCRIPTION: Shell fusiform, elongate of regularly convex whorls with impressed sutures and cut by a spinose keel. Protoconch deviated of two whorls ending abruptly and succeeded by the juvenile spire whorls which have a spinose keel and a spinose lira anterior to it. Posterior whorl slope of adult whorls with three spinose lirae. Anterior whorl slope of body whorl with about six spinose lirae of which three are present on the spire whorls. Aperture oval with the columella covered with a thin curved lamina so that the peristome is entire. Inner side of outer lip with denticles corresponding to the spaces between the lirae. Canal long and straight bearing spinose lirae of which two are more prominent than the rest.

DIMENSIONS:

Holotype	T 485A	L 20	LS 10	HA 3·5	W 6	Juvenile
Hypotype	P26458	26·5	15	4·5	7	
Hypotype	P26459	19	11·5	3·5	6	

LOCATION OF TYPES: Tate Museum, Geology Department, University of Adelaide: Holotype T 485A; National Museum of Victoria: Hypotype P26458, Hypotype P26459, both from F. A. Cudmore Collection.

TYPE LOCALITY: 'Blue clays at Schnapper Point'. Tate cites Muddy Creek as the locality for his figured specimen; however on his original tablet the figured specimen is marked 'Schnapper Point'. The preservation and matrix within the specimen are typical of Fossil Beach, Balcombe Bay, Mornington. Grid Ref. Cranbourne 072,845, Balcombe Clay, Balcombian.

STRATIGRAPHIC RANGE: Balcombian—Bairnsdalian, Middle Miocene.

OCCURRENCE: Balcombe Clay: (Balcombian) Type locality; 200 yds S. of Grices Creek; Upstream section, Grices Creek section 8A of Gostin 1966, Cranbourne 111,910. (Bairnsdalian) Downstream section 8B of Gostin 1966, Grices Creek, lower beds, Cranbourne 111,910.

Newport Formation: (? Balcombian) Altona Bay Coal Shaft No. 2.

Fyansford Clay: (Balcombian) Native Hut Creek, about 2 miles upstream, Geelong 173,034; Red Hill, Shelford-Inverleigh Rd.

Muddy Creek Formation: (Balcombian) Clifton Bank, Muddy Creek.

Gellibrand Clay: (Balcombian) Road cutting near cheese factory 2½ miles N. of Port Campbell.

MATERIAL: Type and forty topotypes.

COMMENTS: This is not a common species in the Balcombian apart from the type locality, and it is quite rare in the Bairnsdalian. It has evolved from *H. piscatorius* sp. nov. by increase in the number of spiral lirae and greater development of spines. However, the striking difference is in the protoconch, which is sharply differentiated from the juvenile spire whorls and lacks the intermediate ribbed stage.

Occasionally individuals attain giant size as shown by two specimens from Clifton Bank whose spire measurements are 27 mm.

Columbarium Martens 1881

Columbarium Martens 1881, *Conchologische Mittheilungen* 2 (1 & 2): 105; Fischer 1883, *Manuel de Conchyliologie* Fasc. 6: 590; Tryon 1884, *Manual of Conchology* 6: 154; Cossmann 1896, *Essais de Paléoconchologie Comparée* 2: 64; Harris 1897, *Catalogue of Tertiary Mollusca* p. 51; Cossmann 1901, *Essais de Paléoconchologie Comparée* 4: 15; Thiele 1925, *Deutche Tiefsee—Expedition* 17 (2): 133; Tomlin 1928, *Ann. S. Afr. Mus.* 25 (2): 330; Thiele 1929, *Handbuch der Systematischen Weichtierkunde* 1 (1): 289; Wenz 1941, *Handbuch der Paläozoologie* 6 (1): 1085; Clench 1944, *Johnsonia* 1 (15): 1; Barnard 1959, *Ann. S. Afr. Mus.* 45 (1): 234.

TYPE SPECIES: (Original Designation): *Pleurotoma (Columbarium) spinicincta* Martens 1881.

DESCRIPTION: Shell fusiform with scalar spire of shouldered whorls. Protoconch of two whorls not sharply differentiated from the spire whorls, the first whorl smooth, globose, deviated perpendicular to the axis of the shell, the second whorl with a median keel at first imperceptible, but developing into a flange which on the later whorls is divided into a series of flattened triangular keel spikes which are open on the apertural side of the spike. Adult whorls shouldered or carinate posteriorly, with a second less strongly developed keel present anteriorly in the form of a stout cord, here called the anterior carina. Axial sculpture of growth striae which on crossing any spiral lirae give rise to small raised scales. Spiral sculpture apart from the anterior carina may or may not be developed. Spiral lirae when present are usually spinose or bear small raised scales. Aperture subquadrate, peristome entire as the columella lip is covered by a curved plate. Outer lip notched at the keel and projected forward and toothed at the position of the anterior carina. Canal long, generally slightly twisted, smooth or with scaly or spinose lirae. Radula and operculum typical of the family.

STRATIGRAPHIC RANGE: Maestrichtian—Recent.

DISTRIBUTION: Europe (Maestrichtian—Paleocene); New Zealand, (Paleocene); Southern United States (Lower Eocene); South-eastern Australia (Upper Eocene—Upper Miocene); Eastern Australia, North Island, New Zealand, Japan, South Africa (Recent).

COMMENTS: The presence of the lamina of the inner lip and the anterior carina distinguish this genus from others in the family. The anterior carina usually has a different appearance from any other spiral sculpture, for example on a spinose shell it usually is made up of small imbricating scales and does not have spines as on the lirae. The tooth on the outer lip is not unlike that of certain genera of the Muricacea which use it to open bivalve shells.

There has been some confusion as to the form of designation of the type species. However, under Article 68 (a) (i) of the Code of Zoological Nomenclature 1964 the form of designation should be stated as by original designation, since Martens used the formula *Pleurotoma* (*Columbarium* n.) *spinicincta* n. as heading to the description of his new species.

Glibert (1963, p. 4) has placed *Fusus danicus* von Koenan 1885 (p. 13, Pl. 1, fig. 10) in the genus *Columbarium*. From an examination of the protoconch of a specimen and the description and figure, however, the author considers that it would be better placed in the genus *Falsifusus* Grabau 1904 which has a similar multispiral protoconch and ribbed early whorls.

Columbarium heberti (Briart and Cornet 1880)

(Pl. 2, fig. 19-21, 26-28; Fig. 3, 9)

Fusus heberti Briart and Cornet 1880, *Mém. Acad. r. Belg.* 43 (1): 20; Pl. 14, fig. 8a-d.
Fusus (Columbarium ?) heberti Vincent 1930, *Mém. Mus. r. Hist. nat. Belg.* 46: 47; Pl. 2, fig. 10.
Fusus bicinctus Kaunhowen 1897, *Paläont. Abh.* 8 (1): 82; Pl. 10, fig. 1-4, non Hutton 1873.
Colus (?) kaunhoweni Finlay 1927b, *Trans. N.Z. Inst.* 57: 504; nom. nov. pro *Fusus bicinctus* Kaunhowen 1897, non Hutton 1873.

DESCRIPTION: Shell fusiform with a gradate spire of prominently shouldered whorls. Protoconch of 1½ small whorls, swollen at mid-whorl, first whorl deviated slightly from the axis of the shell. Initial half of first spire whorl with sharp axial plicae which are present only on the anterior whorl slope of the second whorl. Keel developing at the end of the first spire whorl and nodulose where it is crossed by the plicae. The plicae become stronger and continue on the adult whorls as costae. Keel nodulose throughout adult spire whorls with scales rather than keel spikes on the nodules.

Posterior whorl slope smooth and concave on the early spire whorls but occasionally with a single lira, and flat on the adult whorls and undulate at the keel due to the axial costae of the anterior slope.

Anterior whorl slope with well developed costae and a prominent anterior carina, posterior to which are two less well developed lirae which are somewhat undulate on crossing the costae. The lira next to the keel is also well developed on the spire whorls, giving the spire the appearance of having a double keel. Anterior to the carina are numerous fine lirae which are also present on the canal and bear prominent scales. Canal straight and as long as the spire.

DIMENSIONS:

Lectotype	L 28	LS —	HA —	W —	
Hypotype IRSNB 5333	12	8	—	5	Puits Coppée
Hypotype IRSNB 3309	42	—	—	—	Mesvin-Belian.
Lectotype of *F. bicinctus*	42	—	—	15	Maestricht
Lectoparatype of *F. bicinctus*	66	31	—	15	Maestricht

LOCATION OF TYPES: Faculté Polytechnique de Mons, Mons, Belgium: Lectotype (Briart & Cornet 1880, fig. 8d); Lectoparatype (fig. 8a-c). Institut Royal des Sciences Naturelles de Belgique: Hypotype 5333, Houzeau Collection; Hypotype 3309, Mesvin-Belian, A. Rutot Collection.

Institut für Paläontologie und Museum der Humboldt-Universität zu Berlin: Syntypes of *Fusus bicinctus*, J. Binkhurst Collection.

TYPE LOCALITY: Mons, Hainaut, Belgium: Calcaire de Mons, Montian, Lower Paleocene.

STRATIGRAPHIC RANGE: Maestrichtian—Montian.

OCCURRENCE: Pulaway Beds: (Montian) Nasielow Quarry, Pulaway Region, Central Poland.

Calcaire de Mons: (Montian) Puits Coppée, Mons, Belgium.
Tuffeau de Ciply: (Danian) Mesvin-Belian and Ciply, Hainaut, Belgium.
Tuffeau de Maestricht: (Maestrichtian) Maestricht, Limburg, Netherlands.

MATERIAL: 3 Syntypes of *Fusus bicinctus*. Hypotype from Mesvin-Belian. 4 specimens, Nasielow. Hypotype from Puits Coppée.

COMMENTS: The anterior carina is the most prominent of the spiral sculpture on the body whorl and is identified by the growth lines which are arched toward the aperture above and below and meet at a point on it.

The protoconch of this species is similar to *Columbarium rugatum* (Aldrich) and a little like *Fulgurofusus quercollis* (Harris). The keel spikes so characteristic of later members of the genus are represented by scales which have the same structure as the spikes, i.e. they are compressed and open towards the aperture.

Comparison of specimens of both *Fusus heberti* and *F. bicinctus* reveals that both are identical, having the same general outline and exactly the same pattern of spiral and axial sculpture.

This is the oldest known columbariid and the writer has failed to find any other species from older faunas which could have given rise to it.

Columbarium (?) vulneratum (Finlay and Marwick 1937)

(Pl. 4, fig. 73, 77)

Fulgurofusus vulneratus Finlay and Marwick 1937, *Palaeont. Bull., Wellington* 15: 70; Pl. 9, fig. 12, 13.

DIAGNOSIS: A *Columbarium* with a somewhat conical spire; posterior whorl slope flat to slightly convex and smooth; anterior whorl slope with three lirae.

DESCRIPTION: Shell fusiform with a squat almost conical spire. Whorls cut by a prominent keel bearing short blunt triangular spikes. Posterior whorl slope flat to gently convex sloping gently to the keel. Anterior whorl slope with three lirae, the anterior of which may be the anterior carina. Inner lip of aperture covered with a thin curved plate. Canal long and straight, bearing fine spiral threads.

DIMENSIONS: Holotype: L, 27; W, 11.

LOCATION OF TYPE: Auckland Institute and Museum, Auckland, New Zealand: Holotype, TM/329.

TYPE LOCALITY: N. flank, Boulder Hill, 1½ miles NE. of Salisbury, Otago, New Zealand.

STRATIGRAPHIC RANGE: Wangaloan, Paleocene.

MATERIAL: Holotype.

COMMENTS: Finlay and Marwick compared this species with *C. acanthostephes* (Tate) and suggested that it was ancestral to the latter but preferred to place it in *Fulgurofusus* because of the 'absence of foliar expansions'. However having examined the holotype it appears to the writer to be not unlike a worn *Columbarium* and has considerable similarity to *C. formosissimum* Tomlin. In particular it has the typical columella plate of *Columbarium* which is not present in *Fulgurofusus*. Unfortunately the apex is missing and it is not possible to determine if in fact the lira on the body whorl is the anterior carina because the shell is worn and damaged.

Columbarium rugatum (Aldrich 1886)

(Pl. 2, fig. 15, 24-25; Fig. 14)

Fusus rugatus Aldrich 1886, *Bull. geol. Surv. Ala.* 1: 22; Pl. 5, fig. 9; de Gregorio 1890, *Annls. Géol. Paléont.* 7: 81; Pl. 6, fig. 13; Harris 1896, *Proc. Acad. nat. Sci. Philad.* for 1896, 48: 478; Pl. 22, fig. 8; Harris 1899, *Bull. Am. Paleont.* 3 (11): 43; Pl. 5, fig. 6.
Fulgurofusus rugatus Grabau 1904, *Smithson. misc. Collns.* 44 (1417): 86; Fig. 10.

DIAGNOSIS: A *Columbarium* with an elongate gradate spire and short laterally directed keel spikes; posterior whorl slope smooth and concave, anterior whorl slope with two scabrose lirae posterior to the anterior carina. Canal lirate with prominent scales on the lirae.

Description: Protoconch small, deviated perpendicular to the axis of the shell, paucispiral somewhat angular, second whorl of protoconch with a strong keel which has nodules on the last half whorl of the protoconch which develop into keel spikes on the third whorl. Posterior whorl slope smooth and concave, anterior slope of the spire whorls with two lirae, anterior slope of body whorl with two prominent scabrose lirae posterior to the anterior carina. Canal long and twisted with prominent scaly lirae. Inner lip of aperture not developed into a thin lamina on the two adults available.

Dimensions:

Hypotype	ANSP 6869	L 54	W 13
Hypotype	USNM 645889	47	—

Location of Types: United States National Museum: Holotype No. 638758, Hypotype No. 645889; Academy of Natural Sciences of Philadelphia: Hypotype No. 6869, C. W. Johnson Collection; Hypotype No. 9018, Frank Burns Collection.

Type Locality: Greggs Landing, Alabama R., Monroe County, Alabama, U.S.A., Greggs Landing Member, Tuscahoma Formation. Lower Eocene.

Stratigraphic Range: Lower Eocene.

Occurrence: Type locality: Graveyard Hill, Wilcox County, Alabama ANSP 9018.

Material: 1 Topotype, original of figs. of Harris 1896, Harris 1899 and Grabau 1904. Graveyard Hill, 3 broken juveniles.

Comments: This species does not closely approach any of the early Australian species as it is much more elongate than *Columbarium cochleatum* (Tate) or *C. calcaratum* sp. nov. The protoconch is somewhat intermediate in development between *Fulgurofusus quercollis* (Harris) and *Columbarium cochleatum* (Tate). The presence of a typical anterior carina, the spinose lirae and keel spikes place this species in *Columbarium* rather than *Fulgurofusus*, which lacks these features. Whether the absence of the curved collumella plate on the two figured specimens is characteristic of the species or due to the aperture not being fully developed in them will only be determined by examination of further specimens.

Columbarium cochleatum (Tate 1888)

(Pl. 3, fig. 30, 38, 48, 50; Fig. 17)

Fusus cochleatus Tate 1888, *Trans. R. Soc. S. Aust.* 10: 135; Pl. 8, fig. 9.

Diagnosis: A fusiform *Columbarium* with blunt laterally directed keel spikes; posterior whorl slope convex with a single spinose lira, anterior slope with two spinose lirae posterior to the anterior carina; canal with numerous close set spiny lirae.

Description: Shell fusiform, somewhat elongate with convex, spiny whorls. Protoconch small, globose of two whorls, the first smooth, flattened, deviated perpendicular to the axis of the shell, second whorl with keel crossed by short radial ribs giving keel a nodulose appearance, ribs then fading and nodules develop into typical keel spikes.

Posterior whorl slope convex, smooth for 2½ whorls then with a single spinose lira. Anterior whorl slope with the anterior carina and two spinose lirae posterior to it; the latter are present on the anterior slope of the spire whorls.

Aperture somewhat ovate, peristome continuous, outer lip with a smooth tooth-like projection where it is cut by the anterior carina. Canal straight with numerous spiny lirae.

DIMENSIONS:

Holotype	T 484B	L 27	LS 21	HA —	W —
Hypotype	T 484C	43	21	6	13
Hypotype	SAMP 6495	31	16·5	5	9
Hypotype	NMV P26396	—	14 (approx.)		8·5

LOCATION OF TYPES: Tate Museum, Adelaide University Geology Department: Holotype T 484B, Hypotype T 484C; South Australian Museum Palaeontological Collection: Hypotype P6495, Kimber Collection; National Museum of Victoria: Hypotype P26396, Dennant Collection.

TYPE LOCALITY: Blanche Point, Aldinga Bay, South Australia. Blanche Point Marls, Aldingan, Upper Eocene.

STRATIGRAPHIC RANGE: Aldingan, Upper Eocene.

OCCURRENCE: Type locality only.

MATERIAL: Holotype and 4 topotypes.

COMMENT: Apart from the second whorl of the protoconch this species possesses all the features of a typical *Columbarium* though the convex outline of the whorls separates it from other species of the genus. In this respect it superficially resembles *Hispidofusus senticosus* (Tate 1888) but the protoconch and early whorls are quite unlike that species. The ribbing of the protoconch of *C. cochleatum* is very similar to that of *Fulgurofusus quercollis* (Harris) and *Columbarium rugatum* (Aldrich) and thus it may well have retained some of the primitive features of its ancestors. However, it is not itself ancestral to the other Australian species, as these appear to be derived from the *Columbarium* found in the Upper Eocene Browns Creek Clay.

Columbarium calcaratum sp. nov.

(Pl. 3, fig. 29, 33, 39)

DIAGNOSIS: A *Columbarium* with a high gradate spire, subrectangular whorl profile and posteriorly directed keel spikes; posterior whorl slopes smooth, anterior slope with two or three spinose lirae; canal with regularly spaced prominently spinose lirae.

DESCRIPTION: Spire elongate, shouldered with smooth spire whorls cut by the keel. Keel bearing 9-10 posteriorly directed spikes on the body whorl. Penultimate whorl with a spinose thread contiguous to the anterior suture. Body whorl with posterior slope smooth and almost concave. Anterior slope with one or rarely two lirae posterior to the anterior carina. Canal with regularly spaced lirae bearing prominent spines which occasionally are present on the anterior portion of the body whorl.

DIMENSIONS:

Holotype	P26461	L 44	LS 23	HA 7	W 13	F. A. Cudmore Collection
Paratype	P26463	40	21	7	12·5	G. B. Pritchard Collection

LOCATION OF TYPES: National Museum of Victoria: Holotype P26461, F. A. Cudmore Collection; Paratype P26463, G. B. Pritchard Collection.

TYPE LOCALITY: Geological Survey of Victoria locality A^{w} 1, immediately NW. of Point Flinders, Grid Ref. Aire 367,097. Glen Aire Clay, Upper Aldingan, Lowermost Oligocene.

OCCURRENCE: ? Browns Creek Clay: (Lower Aldingan, Upper Eocene) Washout 11, ¼ mile NW. of the mouth of Browns Creek, Grid Ref. Aire 276,179—1 complete specimen and several fragments; Washout 1, immediately NW. of the mouth of Browns Creek, Grid Ref. Aire $277_5,177_5$—three apices.

Glen Aire Clay: Type locality.

STRATIGRAPHIC RANGE: Lower to Upper Aldingan, Upper Eocene to Lowermost Oligocene.

MATERIAL: Types and thirty topotypes.

COMMENTS: Amongst the meagre material from Browns Creek are several apices with protoconchs similar to *Columbarium cochleatum* (Tate). Whether this means a single population with a variable protoconch or the presence of the latter species cannot be decided until further adult specimens are found.

The Browns Creek specimens differ slightly from topotypes of *C. calcaratum* in that the spire is not as elongate and the keel spikes are not as prominent nor are they posteriorly directed. As only one reasonably complete adult is known from Browns Creek, and in view of the variability of the Point Flinders population, it does not seem advisable at this stage to consider even subspecific status for the Browns Creek population.

From *C. spinicinctum* Martens, *C. calcaratum* may be distinguished by its more angular whorl profile, the overall greater spinosity of the body whorls and the posteriorly directed keel spikes. The Browns Creek specimens have much in common with *C. spinulatum* Cossmann, but that species has not the spinose lirae of the body whorl as in the former, is relatively wider and shorter in the spire, and has prominent spines on the canal.

Columbarium uniliratum sp. nov.

(Pl. 3, fig. 37, 42-43, 45)

DIAGNOSIS: A *Columbarium* with a squat almost conical spire and laterally directed keel spikes. Posterior whorl slope smooth, anterior whorl slope with the anterior carina, and very rarely a lira posterior to it. Canal with two or three thread-like lirae bearing small almost incipient scales or spines.

DESCRIPTION: Shell clavate with a depressed conical spire. Whorls wedge-shaped in profile sloping almost symmetrically above and below the keel. Keel spikes enlarge and diminish in number on last half of the body whorl. Posterior whorl slope smooth and slightly convex. Anterior whorl slope of body whorl with a single prominent lira, the anterior carina, and many incipient spiral threads which are also present on the canal. Rarely there is a second lira posterior to the carina. Aperture subtriangular. Canal with 2 or 3 spinose lirae, the spines being weakly developed.

DIMENSIONS:

Holotype	P26464	L 31	LS 14	HA 6	W 10	
Paratype	P26465	25	15	6·5	11	Just above the ledge
Paratype	P26466	22·5	18	6·5	13	Just above the ledge

Location of Types: National Museum of Victoria: Holotype P26464, Paratype P26465, both from F. A. Cudmore Collection; Paratype P26466, Collected T. A. Darragh III/1966.

Type Locality: Bird Rock Cliffs near Torquay, Grid Ref. Anglesea 378,704, Jan Juc Formation, Janjukian.

Stratigraphic Range: Janjukian, Upper Oligocene.

Occurrence: Jan Juc Formation: (Janjukian). Type locality: Clay bed immediately beneath the Point Addis Limestone, Addiscott Beach, section 5 B100, Raggatt and Crespin 1955, Grid Ref. Anglesea 355,676; N. Bank Barwon R., 3½ miles S. of Birregurra, Colac 864,646.

Material: Types, 6 specimens and 2 fragments.

Comments: This species closely resembles *C. spinulatum* Cossmann and is probably its ancestor. The latter has greater development of lirae and spines on the anterior portion of the body whorl and canal. It also bears a close resemblance to the New Zealand *C. veridicum* Dell but that species has posteriorly directed keel spikes and a canal with no sign of spiral sculpture.

Columbarium acanthostephes echinatum subsp. nov.

(Pl. 3, fig. 41, 44, 53, 56)

Fusus acanthostephes Tate (*partim*) Pritchard 1896, *Proc. Roy. Soc. Vict.* 8: 92.

Diagnosis: A *Columbarium* with a high gradate spire and blunt laterally directed keel spikes. Posterior whorl slope flat to slightly convex with one or two spinose lirae. Anterior whorl slope of body whorl with about four spinose lirae in addition to the anterior carina. Canal with about ten equally developed lirae bearing prominent spines.

Description: Shell with a gradate spire of prominently shouldered whorls. Keel with laterally diverted blunt spikes. Posterior whorl slope flat to slightly convex and always convex at the base of the keel and bearing one or two lirae with prominent small spines. Anterior whorl slope of spire with two spinose lirae, and on the body whorl there are four spinose lirae, generally two near the keel, then the anterior carina, and two others between it and the canal. The lirae of the canal are of equal development and bear prominent uniform spines.

Dimensions:

Holotype P26468	L 51	LS 29	HA 10	W 20	
Paratype P26470	45	26	9·5	17·5	Lower bed. Apex missing.

Location of Types: National Museum of Victoria: Holotype P26468, F. A. Cudmore Collection; Paratype P26470, Atkinson Collection.

Type Locality: 'Upper bed, Table Cape' i.e. Fossil Bluff Sandstone, Fossil Bluff N. of Wynyard, Tasmania. Upper Janjukian/Longfordian.

Stratigraphic Range: Upper Janjukian/Longfordian—Batesfordian. Upper Oligocene—Lower Miocene.

Occurrence: Freestone Cave Sandstone: (Upper Janjukian) Lower bed, Fossil Bluff; Type locality.

Curlewis Formation: (Batesfordian) Shore platform, Curlewis, Grid Ref. Portarlington 578,937.

Gellibrand Clay: (Batesfordian) Cutting on Lavers Hill-Cobden Rd, Kennedys Creek, Grid Ref. Princetown 615,239.

MATERIAL: Types, five topotypes and ten specimens from the lower bed.

COMMENTS: The overall prickly nature of this species is characteristic. It is the first member of the *C. acanthostephes* (Tate) lineage and differs from that species in having a more elongate spire, blunt laterally directed keel spikes and more evenly developed spines on the canal. Also the base of the keel spike is smooth rather than ribbed as in *C. acanthostephes* s.s. Specimens from the type locality of *C. echinatum* are connected to *C. acanthostephes* s.s. by specimens from Curlewis which tend to have the keel spikes slightly produced posteriorly.

Columbarium spinulatum Cossmann 1901

(Pl. 3, fig. 31, 52, 54-55, 57)

Fusus spiniferus Tate 1888, *Trans. R. Soc. S. Aust.* 10: 134; Pl. 7, fig. 1.
Fusus acanthostephes Tate (*partim*) Pritchard 1896, *Proc. Roy. Soc. Vict.* 8: 82.
Columbarium spiniferum Harris 1897, *Catalogue of the Tertiary Mollusca* p. 54.
Columbarium spinulatum Cossmann 1901, *Essais de Paléoconchologie Comparée* 4: 16, footnote nom. nov. for *Fusus spinifer* (sic.) Tate 1888, non Bellardi 1872.

DIAGNOSIS: A *Columbarium* with squat almost conical spire and laterally directed keel spikes. Posterior whorl slope smooth and very convex; anterior whorl slope of body whorl with the anterior carina and one to three lirae.

DESCRIPTION: Shell clavate with a relatively depressed spire. Keel bearing laterally directed keel spikes which bisect the body whorl. Whorls convex, sloping symmetrically above and below the keel. Posterior whorl slope smooth, anterior whorl slope of body whorl with the anterior carina and generally one lira posterior to it, and two or three less prominent lirae with poorly developed spines between it and the canal. Aperture subtrigonal. Canal with many lirae, three or four of which are thick and bear prominent spines.

DIMENSIONS:

Holotype	T 476B	L 33	LS 15	HA 7	W 12	
Hypotype	P26472	31	23	9	18	Canal broken
Hypotype	P26473	39	26	10	20	

LOCATION OF TYPES: Tate Museum, Geology Department, Adelaide University: Holotype T 476B; National Museum of Victoria: Hypotype P26472, Hypotype P26473, both from F. A. Cudmore Collection.

TYPE LOCALITY: 'Gastropod bed of the R. Murray cliffs near Morgan' i.e. four miles downstream from Morgan on the east bank of the R. Murray on Section C, Hundred of Cadell (Ludbrook 1961, p. 53) S.A. Cadell Marl lens of Morgan limestone, Batesfordian, Lower Miocene.

STRATIGRAPHIC RANGE: Upper Janjukian/Lower Longfordian—Batesfordian; Upper Oligocene—Lower Miocene.

OCCURRENCE: Freestone Cove Sandstone Lower bed and Fossil Bluff Sandstone Upper bed: (Janjukian) Fossil Bluff, N. of Wynyard, Tasmania.
Cadell Marl lens: (Batesfordian) Type locality.

MATERIAL: Type and thirty topotypes.

COMMENTS: Closely resembles the living *C. hedleyi* Iredale but that species has relatively wider whorls and more prominent lirae with well developed scales on the body whorl. Also *C. spinulatum* has well developed spines on the canal. The twelve specimens from Fossil Bluff match topotypes in whorl shape and pattern of ornament, the only obvious difference is the slightly larger size of the protoconch in Fossil Bluff specimens, a variable feature not considered of any significance. There are no specimens from Fossil Bluff which connect this species with the population of *C. acanthostephes echinatum* sp. nov. so that Pritchard's assertion (1896, p. 82) that *C. spinulatum* is a synonym of *C. acanthostephes* is not upheld.

Spinifer and *spiniferus* are both alternate spellings of the masculine form of the same adjective, the feminine and neuter forms of which are identical, therefore, under Article 57 (b) (i) of the Code of Zoological Nomenclature 1964, Tate's name is a junior homonym of Bellardi's.

Columbarium acanthostephes acanthostephes (Tate 1888)

(Pl. 3, fig. 47, 49, 51)

Fusus acanthostephes Tate 1888, *Trans. R. Soc. S. Aust.* 10: 133; Pl. 7, fig. 7.
Columbarium acanthostephes Harris 1897, *Catalogue of Tertiary Mollusca* p. 52; Pl. 3, fig. 6a, b; Cossmann 1901, *Essais de Paléoconchologie* 4: 15; Pl. 1, fig. 9; Fig. 5.

DIAGNOSIS: A *Columbarium* with a gradate spire and long posteriorly directed keel spikes, ribbed at base on the anterior side. Posterior whorl slope almost flat with two to four spinose lirae. Anterior whorl slope with five spinose lirae two of which are posterior to the anterior carina. Canal with up to seven lirae with prominent spines.

DESCRIPTION: Shell subfusiform with a gradate spire of well shouldered whorls. Keel with elongate posteriorly directed keel spikes which have, on the base of the anterior side, one or two serrate riblets *en echelon* to the spiral lirae of the shell. Posterior whorl slope almost flat with two to four spinose lirae. Anterior whorl slope of spire with one or two spinose lirae and of the body whorl with five spinose lirae, two posterior to the anterior carina and three between it and the canal. The anterior carina is formed of a series of imbricating scales whereas the lirae bear prominent spines. Aperture subcircular. Canal twisted and lirate, alternate lirae generally bear stronger and more elongate spines.

DIMENSIONS:

Holotype	T 474A	L 56	LS 27	HA 9	W 17
Hypotype	P26449	50	28	10·5	20

LOCATION OF TYPES: Tate Museum, Geology Department, University of Adelaide: Holotype T 474A; National Museum of Victoria: Hypotype P26449, F. S. Colliver Collection.

TYPE LOCALITY: 'Blue clays at Schnapper Point', Fossil Beach, Balcombe Bay. Grid Ref. Cranbourne 072,845. Balcombe Clay, Balcombian Middle Miocene.

STRATIGRAPHIC RANGE: Balcombian.

OCCURRENCE: Balcombe Clay: Type locality; Upstream section, Grices Creek, Section 8A of Gostin 1966, Grid Ref. Cranbourne 111,910; 200 yds S. of Grices Creek.

Newport Formation: Altona Bay Coal Shaft No. 2.

Fyansford Clay: Overburden, lowest bench, just above limestone, Australian Cement Quarry, Batesford; Red Hill, Shelford-Inverleigh Rd.

Gellibrand Clay: Cliffs W. of Gellibrand R.

MATERIAL: Type specimen and fifty topotypes.

COMMENTS: The matrix on the specimen and the preservation of the type indicate that it comes from Fossil Beach to the south of Mornington. The use of the name *acanthostephes* has been restricted to the highly spinose forms which appear to be typical of the Lower Balcombian and which form the 'mid-point' of the *acanthostephes* lineage.

Columbarium acanthostephes vulsum subsp. nov.

(Pl. 3, fig. 32, 35, 40, 46)

DIAGNOSIS: A *Columbarium* with a gradate spire and either laterally or posteriorly directed keel spikes; posterior whorl slope flattened or subconvex with one or two lirae but more often smooth. Anterior slope with five or so lirae with poorly developed spines. Canal lirae bearing small spines which are often reduced to scales.

DESCRIPTION: Shell subfusiform with a gradate spire of well shouldered whorls and with keel spikes which project laterally or slightly posteriorly. The base of the keel spike is either smooth or has a thin poorly developed riblet on the anterior side. Posterior whorl slope flattened or subconcave, either smooth or with one or two spiral threads. Anterior whorl slope of body whorl with three to five lirae which may or may not have small spines. Canal often weakly lirate with poorly developed spines.

DIMENSIONS:

Holotype P26475	L 45	LS 21	HA 8	W 15	
Paratype P26477	35	17	5	11	Manyung Rocks, spinose form.

LOCATION OF TYPES: National Museum of Victoria: Holotype P26475, F. A. Cudmore Collection; Paratype P26477, T. A. Darragh Collection.

TYPE LOCALITY: Middle beds, downstream section Grices Creek, approximately equivalent to beds 8 B, c, d, just inside fence, of Gostin (See Appendix). Grid Ref. Cranbourne 111,910. Balcombe Clay, Upper part. Bairnsdalian.

STRATIGRAPHIC RANGE: Balcombian—Bairnsdalian, Middle Miocene.

OCCURRENCE: Balcombe Clay: (Balcombian) Dennant Creek about 50 yds downstream from Older Basalt, Grid Ref. Cranbourne 110,928. (Bairnsdalian) Lower and Middle beds, downstream section Grices Creek, Grid Ref. Cranbourne 111,910; Cliff S. of Manyung Rocks and N. of sewer and jetty, bed 10B a of Gostin 1966, Grid Ref. Cranbourne 106,903.

Fyansford Clay (Horizon not known) Orphanage Hill, Fyansford. (Balcombian) Native Hut Creek about 2 miles from the mouth, Grid. Ref. Geelong 173,034. (Bairnsdalian) Inverleigh, Western Beach, Geelong, Left bank, Barwon R., Section IV A, Parish of Murgheboluc, Grid. Ref. Geelong 229,982.

Gellibrand Clay: (Horizin not known) Cliffs W. of Gellibrand R. (Bairnsdalian) Road cutting on Timboon-Port Campbell Rd, 100 yds S. of shops at Timboon, Grid Ref. Panmure 892, 534.

Muddy Creek Formation: (Balcombian) Clifton Bank, Muddy Creek.

Bullenmerri Clay: (Bairnsdalian) Lake Bullenmerri, Lake Gnotuk.

Rutledges Creek Member, Port Campbell Limestone: (Bairnsdalian) Rutledges Beach.

MATERIAL: Types and nine topotypes.

COMMENTS: The general pattern of sculpture is similar to *Columbarium acanthostephes acanthostephes* (Tate) but frequently there is only one lira posterior to the anterior carina and those anterior to it are often weakly developed. The most obvious difference, however, is the lack of prominent spines. Specimens stratigraphically older than topotypes such as those from Muddy Creek are generally more spinose and have better developed keel spike riblets whilst specimens from Lake Bullenmerri and Lake Gnotuk are almost entirely smooth. However the overlap in specific characters between populations from all localities examined seems to indicate that the separation from *C. acanthostephes* should be subspecific rather than specific.

Columbarium hedleyi Iredale 1936

(Pl. 4, fig. 65, 69-72, 78; Fig. 8)

Columbarium hedleyi Iredale 1936, *Rec. Aust. Mus.* 19 (5): 316; Pl. 24, fig. 18, 18a.
Columbarium trabeatum Iredale 1936, *Ibid.* 19 (5): 316; Pl. 23, fig. 17.

DIAGNOSIS: A *Columbarium* of tumid whorls with a somewhat squat almost conical spire. Posterior whorl slope smooth and convex; anterior whorl slope of body whorl bearing a prominent spinose lira posterior to the anterior carina and one or two spinose lirae between it and the canal.

DESCRIPTION: Shell with a squat almost conical spire of tumid whorls cut by a keel bearing laterally directed keel spikes. Keel on early whorls produced into a flange and with spikes developing on the third or fourth whorl. Posterior whorl slope smooth and convex; anterior whorl slope of spire smooth and on the body whorl with a spinose lira immediately posterior to the anterior carina and with one or two spinose lirae between it and the canal. Aperture subquadrate. Canal long and twisted and having numerous lirae bearing well developed spines. Radula and operculum typical of the family.

DIMENSIONS:

Holotype	C67025	L 51	W 24	LS —	HA —
Holotype of *C. trabeatum*	C60675	60	27	—	—
Hypotype	F27079	75	26	34	12

LOCATION OF TYPES: Australian Museum, Sydney: Holotype C67025, *C. trabeatum* Holotype C60675; National Museum of Victoria: Hypotype F27079.

TYPE LOCALITY: 23 miles E. of Sydney, N.S.W. Australia. 250 fathoms.

OCCURRENCE: Type locality; Off Broken Bay, N.S.W. 75,100 fathoms; Off Twofold Bay, N.S.W. 45 fathoms; Off Stanwell Park, N.S.W. 75 fathoms.

MATERIAL: Seventeen specimens J. Kerslake, T. Garrard Collections.

COMMENTS: The description of *Columbarium trabeatum* Iredale was based on a worn shell. The species was distinguished by its author on the poorly developed keel spikes and by having an extra lira on the anterior whorl slope of the body whorl. Garrard (1961, p. 29) has already stated that *C. hedleyi* is somewhat variable in morphology and that *C. trabeatum* cannot be accepted as a separate species.

Columbarium pagodoides (Watson 1882)

(Pl. 4, fig. 74, 76; Fig. 19)

Fusus (Colus) pagodoides Watson 1882, *J. Linn. Soc.* Zoology 16: 383.
Fusus pagodoides Watson 1886, *Challenger Report*, Zoology 15 (42): 197; Pl. 14, fig. 3.

DIAGNOSIS: A *Columbarium* with a gradate spire and a thin foliaceous extension of the keel, posterior whorl slope smooth, anterior slope bearing the anterior carina only. Canal lirae with numerous small spines.

DESCRIPTION: Shell with a gradate spire and a large globose somewhat flattened protoconch. Spire whorls with a well developed shoulder and unornamented except for growth lines. Keel produced into a thin slightly upturned flange which has irregular extensions at the extremity. Anterior whorl slope of the body whorl with the anterior carina only. Canal bearing about eight regularly spaced spinose lirae.

DIMENSIONS:

Lectotype BM(NH) 1887.2.9.688	L 51	LS 20	HA 8	W 15	from photograph
AM C2965	38	28	8	12	not including flange

LOCATION OF TYPES: British Museum (Natural History): Lectotype here selected, the specimen originally figured by Watson 1887.2.9.688; Australian Museum, Sydney: Paratype C2965.

TYPE LOCALITY: *Challenger* station 164B, June 13, 1874. Lat. 34°13′S., Long. 151°38′E. 410 fathoms, off Sydney.

MATERIAL: One topotype Australian Museum C2965, one of the original *Challenger* specimens.

COMMENTS: The whorl shape, the presence of the typical anterior carina and the globose deviated protoconch (Fig. 19) are similar to other species of *Columbarium*. However in this species the keel flange present on the early whorls has continued on the adult and has not broken into a separate series of triangular spikes as in other species of the genus. On the specimen examined the outer extremity of the flange near the aperture has a somewhat serrated outline due to the incipient development of spikes. A similar development of the keel has taken place in *Serratifus foliaceus* (Tate).

This species has not been found since the original *Challenger* material was collected and its occurrence off Sydney has been doubted, as some species recorded from station 164B are Atlantic species. However, because of its close relationship with other Australian living and fossil species of *Columbarium*, and because it was dredged from deep water which has not yet been adequately explored, the author is of the opinion that it is an indigenous species.

Columbarium formosissimum Tomlin 1928

(Pl. 4, fig. 67, 75; Fig. 20)

Columbarium formosissimum Tomlin 1928, *Ann. S. Afr. Mus.* 25 (2): 331; Pl 25, fig. 1; Barnard 1959, *Ibid.* 45 (1): 236.

DIAGNOSIS: A *Columbarium* with an elongate spire, smooth spire whorls bisected by a median keel bearing laterally directed triangular projections, posterior whorl slope of body whorl flat and smooth, anterior whorl slope of body whorl with the anterior carina and usually a single lira posterior to it.

DESCRIPTION: Shell gradate with a prominent median keel on the spire whorls, keel bearing laterally directed blunt triangular projections, of which there are ten on the last whorl. Posterior whorl slope flat and smooth, anterior whorl slope of spire whorls smooth; anterior whorl slope of body whorl with the anterior carina and often a single nodulose lira slightly posterior to it. The nodules of the lira occur immediately beneath the projections of the keel. Aperture sub-rectangular, canal straight with a few incipient spiral threads. Radula and operculum typical of the family.

DIMENSIONS:

Holotype	SAM A3501	L 47	LS 26	HA 9	W —
Paratype	SAM A3500	48·5	26	8	15

LOCATION OF TYPE: South African Museum, Cape Town: Holotype SAM A3501, Paratype SAM A3500, both from Pieter Faure Collection.

TYPE LOCALITY: Cape St Blaize, N. by E.¼E., distant 65 miles, 90 fathoms, South Africa.

OCCURRENCE: Type locality; Cape Seal, N. by W½W, distant 55 miles, 87 fathoms; Cape St Francis, NE. distant 29 miles, 75 fathoms; Glendower Beacon (near Port Alfred), N½W, distant 16 miles, 66 fathoms.

MATERIAL EXAMINED: Paratype SAM A3500 and BM(NH) 1962 292.

COMMENTS: In whorl profile and pattern of ornament this species most closely resembles *Columbarium spinicinctum* Martens but is completely devoid of spines or scales on the lirae of the body whorl and canal. The keel also is divided into blunt triangular projections rather than the prominent keel spikes typical of most species of the genus and the body whorl occasionally has well developed nodules or even folds beneath the keel projections.

Columbarium natalense Tomlin 1928

(Pl. 4, fig. 60; Fig. 10)

Columbarium natalense Tomlin 1928, *Ann. S. Afr. Mus.* 25 (2): 331; Pl. 25, fig. 2; Barnard 1959, *Ibid.* 45: 237.

DIAGNOSIS: A *Columbarium* with a gradate spire and posteriorly directed keel spikes; posterior whorl slope flat with three spiral cords, anterior whorl slope with four spiral cords, the anterior carina and four spiral cords between it and the canal. Body whorl with four axial costae near the aperture.

DESCRIPTION: Shell gradate, prominently shouldered with rather coarsely corded spire whorls; keel with 12 posteriorly directed spikes on the last whorl, the bases of which bear four fine scaly threads set *en echelon.* Posterior whorl slope with three spiral cords, anterior whorl slope with three spiral cords between keel and anterior carina and four further cords between it and the canal.

All cords scabrose due to the crossing of the growth lines. Last third of body whorl with four broad costae coincident with the spikes of the keel. Aperture subcircular. Canal elongate, very slightly twisted and bearing five spiral lirae.

DIMENSIONS:

Holotype	SAM A3497	L 37	LS 19	HA 6	W 10

LOCATION OF TYPE: South African Museum: SAM A3497, Pieter Faure Collection.

TYPE LOCALITY: Off Cape Natal, W¾N, 12 miles, 85 fathoms, Durban, S. Africa.

OCCURRENCE: Type locality.

MATERIAL: Holotype, the only specimen known.

Comments: Distinguished from other species of the genus by its lack of spines apart from those of the keel, the wrinkled appearance of the surface of the shell and by the presence of the four broad axial costae on the last third of the body whorl. These axial costae may be due to an accident during growth as they are quite out of harmony with the rest of the shell. The spire whorls are slightly offset giving the spire a crooked appearance which may support this view. Further specimens are required to settle this question.

The only other species of *Columbarium* which approaches *C. natalense* is *C. distephanotis* Melvill from Torres Strait, N. Australia, but that species has well developed costae on all whorls except the first three, and has a prominent nodulose cord between the keel and the anterior carina.

A similar development of lirae on the keel spikes is seen in *Columbarium acanthostephes* (Tate).

Columbarium spinicinctum (Martens 1881)

(Pl. 2, fig. 22-23; Pl. 4, fig. 59, 63, 66, 68; Fig. 15)

Pleurotoma (Columbarium) spinicincta Martens 1881, *Conchologische Mittheilungen* 2 (1 & 2): 105; Pl. 21, fig. 1-3; Kobelt 1886, *Conchylien Cabinet* 4 (3) Part 341: 172; Pl. 34, fig. 1, 2.

Columbarium caragarang Garrard 1966, *J. maloc. Soc. Aust.* 10: 10; Pl. 1, fig. 5.

Diagnosis: A *Columbarium* with a gradate spire of moderately convex whorls bisected by the keel. Posterior whorl slope smooth; anterior whorl slope of spire smooth and on the body whorl bearing the anterior carina and a spinose lira immediately posterior to it.

Description: Shell fusiform with a moderately elongate spire of shouldered whorls cut by a median keel bearing laterally directed keel spikes. Posterior whorl slope convex and smooth. Anterior whorl slope flat and smooth on the spire, and on the body whorl flat, then rapidly contracted to the keel and bearing a prominently spinose lira immediately posterior to the anterior carina. Aperture subquadrate. Canal long and only slightly twisted bearing four or so spinose lirae or with numerous fine lirae bearing prominent scales.

Dimensions:

Holotype	L 67	LS 26	HA 9	W 14·5	
Hypotype F26251	57	26	9	16	
C64800	75	—	7·5	—	Holotype of *C. caragarang*

Location of Types: Institut für Spezielle Zoologie und Zoologisches Museum der Humboldt-Universität zu Berlin: Holotype 26677; Australian Museum, Sydney: Holotype of *C. caragarang* C64800; National Museum of Victoria: Hypotype F26251, J. Berrie Collection.

Type Locality: *Gazelle* Lat. 26°51·1′S; Long. 153°29·6′E. 76 fathoms (139 metres), off Cape Morton 27.9.1875.

Stratigraphic Range: Upper Miocene ?, Recent.

Occurrence: Off Cape Morton in vicinity of type locality, Q'land. 70-100 fathoms.

Material: Twenty specimens. J. Kerslake, T. A. Garrard, J. Berrie Collections.

COMMENTS: The population of *C. spinicinctum* from off Cape Morton exhibits dimorphism. Both forms are exactly alike in size, shape, colour pattern and pattern of sculpture, but differ in degree of development of keel spikes and spines on the lirae of the body whorl and canal. One form, described and illustrated by Martens, has longer and fewer spikes on the keel, and the lirae of the body whorl and canal have well developed spines; the other form, described as *C. caragarang* by Garrard, has more numerous blunt keel spikes, less prominent spines on the lirae of the body whorl and scales on the canal. Garrard (1966, p. 10) suggests that 'the differences . . . . . could possibly be due to sexual dimorphism' and this may well be, but as yet the animal of either form has not been studied. In view of the variability of some of the populations of fossil species e.g. that of *C. acanthostephes*, and the fact that the pattern of sculpture is identical, there are no grounds for maintaining *C. caragarang* as a separate species.

There is a single specimen (P26479) from Rose Hill, Gippsland (Mitchellian, Upper Miocene) which somewhat resembles the *caragarang* form so that *C. spinicinctum* may well range back to the Miocene.

Columbarium distephanotis Melvill 1891

(Pl. 4, fig. 58, 64)

Columbarium distephanotis Melvill 1891, *J. Conch., Lond.* 6 (12): 405; Pl. 2, fig. 4.

DESCRIPTION: Shell elongate, fusiform, with prominently shouldered whorls. Keel bearing short, posteriorly directed keel spikes. Posterior whorl slope flat bearing fine spiral threads. Anterior whorl slope of spire bearing numerous fine spiral threads and a prominent nodulose lira, the nodules of which are formed by short axial costae coincident with each keel spike. On the body whorl the anterior carina is present as well as numerous finer lirae. Aperture pyriform, inner lip covered with a thin glaze. Canal straight.

DIMENSIONS: L 19, W 5.

LOCATION OF TYPE: Manchester Museum: Holotype EE3651, R. Cholmondeley Collection.

TYPE LOCALITY: Dredged in 17 fathoms off S. shores of New Guinea, Torres Straits.

OCCURRENCE: Type locality.

MATERIAL: Photographs of the holotype.

COMMENTS: As yet the holotype is the only specimen of this species known and, as it was not examined, and is a juvenile, the above description and generic allocation should be treated with caution. The development of the cord anterior to the keel suggests *Serratifusus clydoniatus* sp. nov. but that species has no keel spikes. The absence of the characteristic *Columbarium* lamina of the inner lip is typical of juvenile specimens.

Columbarium veridicum Dell 1963

(Pl. 4, fig. 61-62)

Columbarium veridicum Dell 1963, *Trans. R. Soc. N.Z.* Zoology 3 (20): 211; Fig. 1.

DIAGNOSIS: A *Columbarium* with a gradate spire and posteriorly directed keel spikes; posterior whorl slope smooth, slightly convex; anterior slope of body whorl with the anterior carina only. Canal without lirae.

DIMENSIONS:

Holotype M16274	L 69	LS 27	HA 11	W 17·5

LOCATION OF TYPE: Dominion Museum, Wellington, New Zealand: Holotype M16274.

TYPE LOCALITY: 28 miles ENE. of Poor Knights Island 305-340 fathoms, North Is., New Zealand.

OCCURRENCE: Type locality.

MATERIAL: Holotype the only specimen known.

COMMENT: Dell has given a very full description of this unique specimen and differentiated the species from *Columbarium pagoda* on the basis of the direction of projection of the keel spikes which are more upright in *pagoda*, and the lack of any form of spiral sculpture on the canal of *C. veridicum*.

Columbarium pagoda (Lesson 1834)

(Pl. 3, fig. 34, 36)

Fusus pagoda Lesson 1834, *Illustrations de Zoologie* livr. 14; Pl. 40.

Fusus japonicus Gray 1839, *Zoology of Captain Beechey's Voyage* p. 115.

Fusus pagodus Keiner 1840, *Spécies Général et Iconographie* Fuseau, p. 7; Pl. 5, fig. 2.

Fusus pagoda Reeve 1847, *Conchologica Iconica* 4, *Fusus*; Pl. 8, fig.32a, b; Chenu 1859, *Manuel de Conchyliologie* 1: 139, fig. 593.

Fusus diadema Sowerby 1880, *Thesaurus Conchyliorum* 4: 79; Pl. 410, fig. 53, *lapsus* for *pagoda*.

Fusus pagoda Kobelt 1880, *Conchylien-Cabinet* III, 3b: 159; Pl. 49, fig. 4, 5; Tryon 1881, *Manual of Conchology* 3: 51; Pl. 32, fig. 86.

Pleurotoma (Columbarium) pagoda Martens 1881, *Conchologische Mittheilungen* 2 (1 & 2): 106; Pl. 21, fig. 4.

Fusus pagoda Dunker 1882, *Novitates Conchologicae* Abt. II, Suppl. VII: 13; Pl. 1, fig. 8-10.

Columbarium pagoda Tryon 1884, *Manual of Conchology* 6: 175; Pl. 7, fig. 98; Y. Hirase 1914, *Illustrations of a Thousand Shells* 1; Pl. 2, fig. 6.

Columbarium pagodus Thiele 1929, *Handbuch der Systematischen Weichtierkunde* 1 (1): 289, fig. 312.

Columbarium pagoda Clench 1944, *Johnsonia* 1 (15): 4; Pl. 1, fig. 2; Hirase and Taki 1951, *Illustrated Handbook of Shells* Pl. 108, fig. 1; Habe 1953, *Illustrated Catalogue of Japanese Shells* 23: 181; Fig. 20, 21.

Columbarium pagoda forma *stellata* Habe 1953, *Ibid.* 23: 181; Fig. 18, 19.

Columbarium pagoda Kira 1954, *Coloured Illustrations of the Shells of Japan* I, p. 47; Pl. 23, fig. 11.

Columbarium pagoda stellare Habe 1961, *Ibid.* II, p. 68; Pl. 33, fig. 23.

Columbarium pagoda Kira 1962, *Shells of the Western Pacific* 1: 64; Pl. 24, fig. 19; Dell 1963, *Trans. R. Soc. N.Z. Zoology* 3 (20): 209, fig. 2.

Columbarium pagoda costata Shikama 1963, *Sci. Rep. Yokohama natn. Univ.* Ser. II, No. 10: 61; Pl. 1, fig. 1-2.

Columbarium pagoda stellare Habe 1964, *Shells of the Western Pacific* II: 105; Pl. 33, fig. 23.

DIAGNOSIS: An elongate *Columbarium* with prominently shouldered whorls and posteriorly directed keel spikes. Posterior whorl slope smooth; anterior whorl slope usually smooth apart from the anterior carina.

DESCRIPTION: Shell elongate, fusiform with an elongate gradate spire of prominently shouldered whorls usually bearing posteriorly directed keel spikes. Posterior whorl slope smooth, convex to concave; anterior whorl slope with the anterior carina and generally no other spiral sculpture apart from a few threads near the beginning of the canal. Aperture subquadrate. Canal long, twisted with several weak lirae bearing small scales.

Dimensions: Holotype 1108/7, L 44.

Location of Type: Holotype, Muséum d'Histoire Naturelle, Geneva: 1108/7, Delessert Collection.

Type Locality: Not known.

Occurrence: Southern Honshu, Kyushu, Shikoku, Japan.

Comments: The original illustration shows that the holotype had a shortened canal which was probably broken, as all specimens of *C. pagoda* which have been examined have much longer canals with two prominent twists. Lesson gives the measurement of his specimen as 20 lignes in length (45 mm) and the specimen in the Delessert Collection has a shortened canal (broken, E. Binder pers. comm.) and is 44 mm in length. The holotype was in the collection of Prince Masséna d'Essling, Duke of Rivoli, who sold his collection to Benjamin Delessert in 1840. Therefore there is no doubt that specimen 1108/7 in the Delessert Collection is the holotype. It has been figured previously by Chenu in his *Manuel*.

There are two infra-specific names which have been applied to *C. pagoda*. The first *C. pagoda* forma *stellatum* Habe 1953 (p. 182 as *stellata*) was applied to 'those individuals with larger shell, few spines of larger size which radiate in rather horizontal manner, but there exist all kinds of transitional forms between (the) two'. Subsequently the name has been used with a different spelling (*stellare*) as a subspecies of *C. pagoda* (Habe 1961, p. 68) but this is not warranted as the forms appear to make up portion of the 'typical' population of *C. pagoda*. The second name *C. pagoda costatum* Shikama 1963 (as *costata*) applies to a group of shells having prominent spinose lirae in addition to the anterior carina. The information on this group is limited and, as yet, no attempt has been made to map their distribution, but there is a distinct possibility that the subspecies may be recognized for the west coast shells, whilst *C. pagoda pagoda* would apply to the east coast group.

Histricosceptrum gen. nov.

Type species: *Columbarium atlantis* Clench and Aguayo 1938.

Etymology: L., *Histrix,-icis*, f. porcupine; L., *sceptrum,—i*, staff; gender neuter.

Description: Shell elongate, fusiform of convex whorls cut by a keel bearing long hollow spines. Protoconch smooth globose of 1½ whorls, the first whorl deviated perpendicular to the axis of the shell, the second with a keel at the mid-whorl and merging imperceptibly with the spire whorls. Adult whorls convex, strongly lirate. Axial sculpture of growth striae only. Aperture sub-circular, typically with the inner lip covered with a thin glaze. Outer lip notched at the keel. Canal long and straight.

Distribution: Carribbean; West Africa? (Recent).

Comments: This genus has a *Columbarium* type of protoconch but lacks the anterior carina and on the type species the inner lip is covered only with a thin glaze. The African species *Columbarium canaliculatum* Martens 1901 which appears to belong to the group of *H. atlantis* has a plate covering the inner lip, but as yet there are not sufficient specimens to hand fully to assess this feature. It differs from *Fulgurofusus* in having prominent spines on the keel and well developed spiral lirae.

Histricosceptrum atlantis (Clench and Aguayo 1938)

(Pl. 6, fig. 119, 112; Fig. 1)

Columbarium atlantis Clench and Aguayo 1938, *Mems. Soc. cub. Hist. nat.* 12 (5): 382; Pl. 28, fig. 1; Clench 1944, *Johnsonia* 1 (15): 2; Pl. 1, fig. 4.

Diagnosis: A *Histricosceptrum* with a very elongate spire and regularly convex whorls cut by a keel bearing long anteriorly directed tubelike spines.

Description: Shell with a long narrow spire of very convex whorls which are cut by a prominent keel set close to the anterior suture. Keel bearing anteriorly directed tubelike spines. Posterior whorl slope bearing three or four irregularly spaced spiral ridges. Anterior whorl slope of body whorl with four to five coarser lirae which continue onto the posterior half of the canal. Aperture semicircular. Canal long and straight.

Dimensions:

Holotype	MCZ 135004	L 35	LS 15	HA —	W 6
Hypotype	MCZ 135170	32	16	3·5	7
	MCZ 178190	34	17	4·5	7

Location of Types: Museum of Comparative Zoology, Harvard University: Holotype MCZ 135004, Hypotype MCZ 135170; Museo Poey, Habana, Cuba: Paratype.

Type Locality: *Atlantis* Station No. 2999 Lat. 23°10′N, Long. 81°29′W off Matanzas, Cuba, 230 fathoms.

Occurrence: Four stations in the vicinity of the type locality, Cuba.

Material: Two specimens, MCZ 135170, MCZ 178190.

Comments: The elongate spire, the convex whorls with simple lirate sculpture, and the anteriorly directed spines separate this species from the two others in this genus.

Histricosceptrum bartletti (Clench and Aguayo 1940)

Columbarium bartletti Clench and Aguayo 1940, *Mems. Soc. cub. Hist. nat.* 14 (1): 86; Pl. 14, fig. 3; Clench 1944, *Johnsonia* 1 (15): 3; Pl. 1, fig. 5.

Diagnosis: A *Histricosceptrum* with an elongate spire and channelled suture. Posterior whorl slope concave with a series of radial ribs adjacent to the posterior suture. Anterior whorl slope regularly convex with about six coarse lirae.

Description: Shell with a long narrow spire and laterally directed keel spikes. Posterior whorl slope convex with numerous prominent radial ribs close to the posterior suture forming a deep channel adjacent to the suture. Anterior whorl slope of body whorl regularly convex with numerous coarse lirae which extend onto the posterior half of the canal. Aperture sub-quadrate, canal long and straight.

Dimensions:

Holotype	MCZ 104729	L 39	LS 19	HA 5·5	W 8
Paratype		35	16	—	8

Location of Types: Museum of Comparative Zoology, Harvard University: Holotype MCZ 104729; Museo Poey, Habana, Cuba: Paratype.

Type Locality: *Blake* Station 9. Lat. 18°12′N, Long. 78°20′W. Off Homers Cove, Westmoreland, Jamaica 254 fathoms.

OCCURRENCE: Type locality.

MATERIAL: The above description was compiled from the original description and figure.

COMMENTS: The species is similar in form to *H. atlantis* (Clench and Aguayo) but the channelled suture and radial ribs distinguish it from that species.

Histricosceptrum canaliculatum Martens 1901

(Pl. 6, fig. 108, 111; Fig. 2)

Columbarium canaliculatum Martens 1901, *Sber. Ges. naturf. Freunde Berl.* for 1901, p. 20; Martens 1903, *Deutsche Tiefsee—Expedition* 1898-99, 7 (1): 92; Pl. 2, fig. 7; Theile 1925, *Ibid.* 17 (2): 167; Pl. 46, fig. 23 (radula).

DIAGNOSIS: A *Histricosceptrum* with a somewhat squat conical spire and channelled suture. Posterior whorl slope convex with a prominent spiral cord close to the posterior suture. Anterior whorl slope convex with numerous coarse lirae.

DESCRIPTION: Shell with a squat conical spire and short posteriorly directed tubelike spines. Posterior whorl slope with a prominent spiral cord adjacent to the posterior suture causing it to be channelled and a fine lira between the cord and the keel. Anterior whorl slope regularly convex with five or so prominent lirae of which the posterior is wrinkled beneath the base of each spine. The lirae extend onto the posterior half of the canal. Aperture subtriangular; peristome continuous in some specimens. Canal long and straight.

DIMENSIONS:

Holotype	61028	L 35	LS 14	HA 4·5	W 9

LOCATION OF TYPE: Institut für Spezielle Zoologie und Zoologisches Museum der Humboldt-Universität zu Berlin: Holotype 61028.

TYPE LOCALITY: *Valdivia* Station 245. Trawl. Lat. 5°27′S, Long. 39°18′E. 400 metres off Zanzibar, East Africa.

OCCURRENCE: *Valdivia* Stations 242, 243 off Zanzibar 400 metres in the vicinity of the type locality. John Murray Expedition Station 105, 310 metres near the type locality 5°35′S, 39°14′E.

MATERIAL: Holotype.

COMMENTS: The author was able to examine briefly nine specimens from the John Murray Expedition. Some of these had the inner lip developed into a lamina as in *Columbarium* s.s. However it seems advisable at this stage to place *canaliculata* with the Carribbean species because of their otherwise close affinity. Further work on the East African species may show that it would be better placed in *Columbarium.*

Serratifusus gen. nov.

TYPE SPECIES: *Fusus craspedotus* Tate 1888.

ETYMOLOGY: L. *serratus, -i.* m. denticulated like a saw; L. *fusus, -i,* m. spindle; gender masculine.

DESCRIPTION: Shell fusiform with convex whorls cut by a prominent keel which bears short triangular spikes. Protoconch of 1½ whorls, the first deviated at about 45° to the axis of the spire, the second smooth but differentiated from the spire whorls by two or three prominent axial plicae. First spire whorl keeled and with well developed axial costae which form nodules on crossing the keel. Costae present for two or three whorls, then fading. Keel well developed on the adult whorls and bearing short triangular spikes, or rarely, produced into a flange. Axial sculpture on adult whorls of growth striae which are frequently raised into small scales on crossing the spiral sculpture. Spiral sculpture may or may not be well developed. Aperture semicircular, columella covered with a thin glaze, outer lip reflected slightly in mature individuals, and sometimes denticulate within and notched at the keel, canal long and usually slightly twisted.

STRATIGRAPHIC RANGE: Lower—Middle Miocene.

DISTRIBUTION: E. South Australia; Victoria; N. Tasmania.

COMMENTS: The prominent axial ribs on the final whorl of the protoconch, the ribs of the early spire whorls, the absence of a curved lamina on the columella lip and the prominent keel with spikes distinguish this genus.

Harris (1897, p. 135) is the only author who seems to have realized that *Fusus craspedotus* Tate does not belong with those Australian species traditionally classified as *Columbarium* s.s. His reasons are essentially those outlined in the previous paragraph. He preferred to place it in the Fasciolariidae but its considerable resemblance to *Coluzea* has led the writer to retain the genus in the Columbariidae. Its affinities with *Hispidofusus* have already been discussed.

Serratifusus scabrosus sp. nov.

(Pl. 5, fig. 84, 101, 105)

DIAGNOSIS: An elongate fusiform *Serratifusus* with regularly convex whorls cut by a keel bearing short triangular spikes. Posterior whorl slope with four distinct lirae bearing small scales. Anterior whorl slope of body whorl with about six prominent scale bearing lirae of which two are present on the spire.

DESCRIPTION: Shell elongate fusiform with a high spire of regularly convex whorls. Keel bisecting spire whorls and bearing blunt spikes. Posterior whorl slope with about four well developed scale bearing lirae; anterior whorl slope of spire whorls with two lirae and on the body whorl with six. Axial ribs persisting to about the fourth whorl and then confined to the bases of the keel spikes. Growth striae raised into minute scales on crossing the spiral sculpture. Aperture oval with prominent denticulations on the outer lip.

DIMENSIONS:

Holotype	P26480	L 47	LS 35	HA 11	W 19	Canal broken
Paratype	P26481	27	15·5	5·5	8	Juvenile
Figured specimen	P26483	46	29	10	15	Lower bed, Fossil Bluff

LOCATION OF TYPES: National Museum of Victoria: Holotype P26480, F. A. Cudmore Collection; Paratype P26481, Collected NMV 14.12.1967; Figured specimen P26483, F. A. Cudmore Collection.

TYPE LOCALITY: Fischers Point, Aire R., exact horizon unknown. The species is restricted to the lower mollusc horizon from whence came the paratype 20-30 ft above Lake Craven, SE. side Fischers Point, Grid Ref. Aire 359,158. Lower Fishing Point Marl. Longfordian.

STRATIGRAPHIC RANGE: Janjukian/Longfordian—Longfordian.

OCCURRENCE: ? Upper and lower beds, Table Cape, Tasmania; Type locality.

MATERIAL: Types and eight other specimens.

COMMENTS: Unfortunately, the only well preserved, complete, adult specimen is not precisely located stratigraphically. However, the author is satisfied that the specimen came from the same locality and horizon as the paratype because the preservation, which is very characteristic for the lower mollusc horizon, is identical with that of the paratype.

The specimens from Tasmania are provisionally included in this species until better preserved specimens are available. The whorl profile is not so convex as in topotypes, and the axial ribbing at the bases of the keel spikes is more prominent. As the specimens are somewhat worn there are no signs of scales. The Tasmanian specimens bear a striking, if somewhat superficial, resemblance to the fasciolariid *Falsicolus kaiparaensis* (Suter 1917) from Pakarangi Point, Kaipara Harbour, New Zealand (Otaian, Lower Miocene).

Serratifusus bovarius sp. nov.

(Pl. 2, fig. 8, 11-13)

DIAGNOSIS: An elongate *Serratifusus* with slightly convex whorls cut by a serrate keel. Whorl slopes with many fine, somewhat irregular spiral threads, some of which may be coarser and bear small scales where the growth lines cross them. Canal almost straight with two slight kinks.

DESCRIPTION: Shell elongate fusiform with slightly convex whorls cut by the keel which bears blunt triangular spikes. Posterior whorl slope slightly convex with 10-15 spiral threads, which are somewhat irregular due to their interruption by the growth lines. Occasionally two or three of the threads are coarser and the growth lines are produced into scales where they cross them. Anterior whorl slope with 20-30 lirae which are similar on the posterior slope, with occasionally every second or third thread coarser than the others, and with scales. Aperture subtriangular, canal long and twisted bearing numerous fine spiral threads.

DIMENSIONS:

Holotype	P26485	L 32·5	LS 20	HA 7·5	W 11·5	
Paratype	P26484	29	20	8	12	Curlewis

LOCATION OF TYPES: National Museum of Victoria: Holotype P26485, Collected T. A. Darragh 27.4.1968; Paratype P26484, F. A. Cudmore Collection.

TYPE LOCALITY: Geological Survey locality F^{c} 20. Amphitheatre S. of Bull Is., Leigh R. about 60 ft above flood plain, just above sands and first prominent limestone ledge. Grid Ref. Rokewood 058,156.

STRATIGRAPHIC RANGE: Batesfordian (Lower Miocene).

OCCURRENCE: Fyansford Clay: (Batesfordian) Type Locality.

Curlewis Formation: (Batesfordian) Belmont; G.S.V. locality A^{d} 14. Block 1. Section 24, Parish of Moolap; A^{d} 12, section 23, Block 1, Parish of Moolap.

Fishing Point Marl—Upper Part: (Batesfordian) On Fischers Point 70′-80′ above Lake Craven, Upper mollusc horizon, Grid Ref. Aire 352,163.

Gellibrand Clay: (Batesfordian) Cutting 1·2 miles SW. of Melrose Rd on Princetown-Cobden Rd, Grid Ref. Princetown 032,348. Cutting Lavers Hill-Cobden Rd at Kennedys Creek, Grid Ref. Princetown 615,239.

Glenelg Group: (Batesfordian) Limestone Creek, Glenelg R.

Material: Type and thirteen topotypes.

Comments: This species is possibly the ancestor of *Serratifusus craspedotus* (Tate) which it closely resembles, but the overall pattern of ornament is less scabrose, the lirae are finer and more uniform in development and the canal is almost straight. The specimens of *Serratifusus craspedotus* (Tate) from the R. Murray, in particular, show close affinity and are probably only a little younger in age.

At Fischers Point there occur specimens of a related *Serratifusus* which could have given rise to *S. foleaceus* (Tate) by the flattening of the posterior whorl and the recurving and fusion of the keel spikes. Only two or three individuals have been found and their horizon is not known.

Serratifusus (?) youngi (Chapman 1922)

(Pl. 5, fig. 88-89; Fig. 24)

Fusinus youngi Chapman 1922, *Proc. Roy. Soc. Vict.* 35 (1): 14; Pl. 3, fig. 20.

Diagnosis: An extremely narrow, elongate *Serratifusus* lacking a keel and with sharp nodules on the periphery of the whorls.

Description: Shell elongate, fusiform with whorls sloping gently to the shoulder which bears sharp, slightly elongate nodules. First two juvenile spire whorls ribbed but thereafter there is no trace of axial ribbing. Anterior and posterior whorl slopes bearing numerous close set spiral threads, which are crossed by fine growth striae giving a slightly cancellate appearance to the surface of the whorls. Aperture semicircular, the inner lip covered only with a thin glaze. Canal relatively short, about as long as the spire and straight.

Dimensions:

Holotype	P13246	L 27	LS 18·5	HA 6	W 6·5

Location of Types: National Museum of Victoria: Holotype P13246, J. H. Young Collection.

Type Locality: 'Curlewis'. Curlewis Formation, Batesfordian.

Stratigraphic Range: Batesfordian, Lower Miocene.

Occurrence: Curlewis Formation: (Batesfordian) Type Locality; Well sinking at Belmont; Geological Survey locality F^{c} 20, Amphitheatre S. of Bull Is.; Leigh R. 60 ft above flood plain, Grid Ref. Rokewood 058,156.

Fishing Point Marl: (Horizon not known) Fischers Point, Aire R.

Gellibrand Clay: (Batesfordian) Cutting Lavers Hill-Cobden Rd at Kennedys Creek, Grid Ref. Princetown, 615,239.

Myaring beds, Glenelg Group: (Batesfordian) Caldwells Cliff, Glenelg R.; Listers Cliff, Glenelg R.

Material: Type and five topotypes.

Comments: This species has been placed provisionally in *Serratifusus* because of the evidence from the protoconch and early whorls. However, it is not unlikely that it is a fusininid, as *Fusinus* for example, has a similar type of protoconch.

Serratifusus craspedotus (Tate 1888)

(Pl. 5, fig. 102-104; Fig. 21)

Fusus craspedotus Tate 1888, *Trans. R. Soc. S. Aust.* 10: 134; Pl. 8, fig. 4; Harris 1897, *Catalogue of Tertiary Mollusca* p. 134.

DIAGNOSIS: A *Serratifusus* with rather tumid whorls bisected by a serrate keel. Posterior whorl slope bearing two to four spiral threads; anterior whorl slope of body whorl with a prominent lira which is coincident with the suture on the earlier whorls, and three or four other threads present between it and the canal.

DESCRIPTION: Shell fusiform with rather tumid whorls cut by a serrate keel, bearing prominent triangular spikes. Posterior whorl slope with two to four and occasionally more irregular spiral threads. Anterior whorl slope of body whorl with many spiral threads of which four to eight are more prominent, and the most prominent of these is coincident with the suture of the earlier whorls. Surface of whorl crossed by growth striae which give the surface a roughened appearance. Frequently the striae are raised into scales where they cross the spiral lirae. Aperture subtriangular with a reflected outer lip, denticulated within in mature specimens. Canal long, strongly twisted and bearing three or four scaly lirae.

DIMENSIONS:

Holotype T 466A	L 47	LS 34	HA 13	W 22	
Hypotype P26487	65	40	16	27	Fossil Beach

LOCATION OF TYPES: Tate Museum, Geology Department, University of Adelaide, S.A.: Holotype T 466A; National Museum of Victoria: Hypotype P26487, F. A. Cudmore Collection; Hypotype P26488, T. A. Darragh Collection.

TYPE LOCALITY: Lower beds at Muddy Creek. Clifton Bank, Muddy Creek, Hamilton. Muddy Creek Formation, Balcombian. Middle Miocene.

STRATIGRAPHIC RANGE: Batesfordian—Balcombian.

OCCURRENCE: Type locality.

Balcombe Clay: (Balcombian) Fossil Beach, Balcombe Bay. Grid Ref. Cranbourne 072,845; Section 8A of Gostin 1966, upstream section Grices Creek, Grid Ref. Cranbourne 111,910; Section 7A of Gostin 1966, Dennant Creek 30-40 yds downstream from the Older Volcanics, Cranbourne 120,928; Beach 200 yds S. of Grices Creek.

Newport Formation: (Balcombian) Altona Bay Coal Shaft No. 2.

Fyansford Clay: (Balcombian) Geological Survey locality A^{d} 28, Orphanage Hill, Fyansford; Overburden, lowest bench, just above limestone, Australian Cement Quarry, Batesford; Red Hill, Shelford-Inverleigh Rd; Left Bank, Native Hut Creek, SW. of Glenleigh, Grid Ref. Geelong 173,034.

Gellibrand Clay: (Balcombian) W. of Gellibrand R.

Morgan Limestone, Cadell Marl Lens: (Batesfordian) Cliffs left bank R. Murray 4 miles S. of Morgan; Section C, hundred of Cadell, S.A.

MATERIAL: Type and thirty topotypes.

COMMENTS: Topotypes of this species are somewhat variable in their shape and sculpture, some being rather squat, others elongate, some relatively smooth, others scabrose. Specimens from Balcombe Bay are not so variable and are very like Tate's type specimen. The oldest population stratigraphically is that from the Murray cliffs in which smoother forms are common; the whorls are not as scabrose nor convex as topotypes and suggest derivation from a form such as *S. bovarius* sp. nov. In Victoria the species is confined to the Balcombian and no Batesfordian examples are known, which poses a slight problem as to its origin. Apparently it did not evolve directly from the Victorian Batesfordian *S. bovarius* but migrated from the west.

Serratifusus foliaceus (Tate 1888)

(Pl. 5, fig. 85, 92, 98)

Fusus foliaceus Tate 1888, *Trans. R. Soc. S. Aust.* 10: 132; Pl. 7, fig. 10.
Columbarium foliaceum Harris 1897, *Catalogue of Tertiary Mollusca* p. 53; Cossmann 1901, *Essais de Paléochonchologie Comparée* 4: 15; Pl. 1, fig. 8.

DIAGNOSIS: A *Serratifusus* with a gradate spire and prominently flanged keel. Posterior whorl slope flat and smooth; anterior whorl slope of body whorl convex and bearing 8-10 coarse lirae.

DESCRIPTION: Shell subfusiform with a gradate spire of prominently shouldered whorls. Keel produced into a thin lamina which is curved posteriorly and in the early whorls almost touches the spire. Anterior side of flange sculptured with numerous oblique threads. Shoulder of whorls flat and smooth. Anterior whorl slope of body whorl convex and bearing 8-10 rather coarse lirae, two or three of which are more prominent and set in the middle of the anterior part of the whorl. Aperture subquadrate. Canal long, slightly twisted and bearing almost obsolete lirae.

DIMENSIONS:

Holotype	T 486A	L 44	LS 27	HA 9·5	W 16	
Hypotype	P26489	58	24	10	15	Fossil Beach

LOCATION OF TYPES: Tate Museum, Adelaide University Geology Department: Holotype T 486A; National Museum of Victoria: Hypotype P26489, F. A. Cudmore Collection.

TYPE LOCALITY: 'Lower beds at Muddy Creek' i.e. Clifton Bank, Muddy Creek near Hamilton, Victoria. Muddy Creek Formation, Balcombian.

STRATIGRAPHICAL RANGE: Balcombian (Middle Miocene).

OCCURRENCE: Type locality.
Gellibrand Clay: (Balcombian) 2½ miles W. of the mouth of the Gellibrand R.
Newport Formation: (Balcombian) Altona Bay Coal Shaft No. 2.
Fyansford Clay: Orphanage Hill, Fyansford horizon not known; Griffins, left bank, Moorabool R. at water level, Geelong 373,996; Red Hill, Inverleigh Rd, South of Shelford; Native Hut Creek about 2 miles from the mouth, Geelong 173,034.
Balcombe Clay: (Balcombian) Fossil Beach, Balcombe Bay, Cranbourne 072,845; 200 yards S. of Grices Creek; Dennant Creek about 50 yds downstream from the Older Basalt, Cranbourne 120,928. Grices Creek, exact horizon not known, but not collected in recent years in the downstream section.
Gellibrand Clay: (Balcombian) Port Campbell Cheese Factory; Chapples Locality, ¾ mile upstream from the mouth of La Trobe Creek.

MATERIAL: Type and twenty topotypes.

COMMENTS: Specimens from Balcombe Bay have a rather scabrose appearance due to the development of minute scales where the growth lines cross the spiral lirae. Most specimens from other localities also showed this feature to some extent but it varies according to the locality. The first three localities are grouped together, as specimens from these do not show this feature. Larger series of specimens from all localities may show that this feature is of stratigraphic significance.

Serratifusus foleaceus has a typical *Serratifusus* apex. The deviated protoconch is smooth for 1½ whorls and the last ¼ whorl has three or four vertical ribs; the keel then develops suddenly and is crossed by axial ribs giving it a nodulose appearance. The keel is present for another ½ whorl, then the radial ribs fade rapidly and the keel is produced into a flange. The gradual development of the flange is similar to that in *Columbarium pagodoides* (Watson) but that species has a typical *Columbarium* type of protoconch and does not have ribs on the first quarter of the adult whorls.

Serratifusus foleaceus has developed from the *craspedotus* stock in the Batesfordian by laminate development of the keel. Certain juvenile species of *Serratifusus craspedotus* from Morgan are very close in shape to specimens of *S. foleaceus* which have had the flange worn down. The ancestor of the species seems to be that which occurs at Fischers Point with *S. bovarius* sp. nov. Unfortunately there are not sufficient specimens to permit description, except to say that it is intermediate in form between *S. foleaceus* and *S. bovarius*. The horizon is not known, but the preservation and adherent matrix suggests the upper mollusc horizon 70-80 ft above Lake Craven, near the tip of Fischers Point.

Serratifusus clydoniatus sp. nov.

(Pl. 5, fig. 79, 87, 90, 99)

Diagnosis: A *Serratifusus* with a gradate spire and sharply shouldered whorls. Keel with blunt posteriorly directed spikes. Posterior whorl slope somewhat undulate on the juvenile whorls but concave to slightly convex with a few very fine spiral threads on the body whorl. Anterior whorl slope only slightly convex, attenuating abruptly at the suture with a prominent lira anterior to the keel, which is produced into elongate nodules beneath the keel spikes.

Description: Shell with a gradate spire and an impressed suture. Whorls angular, almost flattened above and below the keel on the body whorl, but undulate on the penultimate whorl. Keel with thickened and rounded spikes which are directed posteriorly. Spikes bearing thin threads which are offset to the sculpture of the whorls. Posterior whorl slope of body whorl flattened or somewhat concave with very thin, almost obsolete spiral threads. Anterior whorl slope slightly convex bearing numerous spiral threads one of which, situate immediately beneath the keel, is stronger and is raised into low elongate sharp nodules beneath the keel spikes. These nodules decrease in size and are not present on the body whorl. Aperture subtriangular. Canal long and twisted bearing obsolete spiral threads.

Dimensions:

Holotype	P26491	L 51	LS 24	HA 10·5	W 18	Murgheboluc 2B
Paratype	P26494	41	21	9	15	
Paratype	P26492	38	26	11·5	19	

Location of Type: National Museum of Victoria: Holotype P26491, Paratype P26492, both Collected T. A. Darragh 6.4.1968; Paratype P26494, F. A. Cudmore Collection.

Type Locality: Cliff 0-10 ft above Barwon R. (N. left bank), Section 4A Parish of Murgheboluc near junction of Bruces Creek and Barwon R. Grid Ref. Geelong 229,982. Bairnsdalian (Lower?)

Stratigraphic Range: (Lower?) Bairnsdalian, Middle Miocene.

Occurrence: Fyansford Clay: (Bairnsdalian) Type Locality, Cliff section left bank Barwon R., section 2B Parish of Murgheboluc, Grid Ref. Geelong 197,988; Cliff section left bank Leigh R. due N. of Inverleigh, Grid Ref. Geelong 138,007;

Leigh R. above Inverleigh Bridge; Native Hut Creek, 100 yards S. of Hamilton Highway, Grid Ref., Geelong 181,010; Orphanage Hill, Fyansford, horizon unknown.

Balcombe Clay: Shore platform at Manyung Rocks, just beneath Baxter Sandstone, Grid Ref. Cranbourne 106,903; Grices Creek, horizon not known, Grid. Ref. Cranbourne 111,910.

Gellibrand Clay: Cliffs 2½ miles W. of the mouth of Gellibrand R., horizon not known.

MATERIAL: Types, two adult topotypes and numerous broken or juvenile topotypes; 5 adult specimens from Murghebolue 2B.

COMMENTS: This species has evolved from *Serratifusus craspedotus* (Tate) but as yet the intermediates in the development have not been adequately documented in the Geelong area, due to lack of suitable exposures and/or faunas. Unfortunately, for localities where it may be possible to demonstrate its development such as Fyansford or Gellibrand, no zonal collections have been made. At both these localities *Serratifusus craspedotus* Tate and *S. clydoniatus* sp. nov. occur together in the Museum collections, but the author has not found them together in the Inverleigh or Murghebolue areas. Thus it would appear that in the past more than one fauna from certain localities have been collected and mixed together.

As there are two juvenile specimens only, known from Grices Creek and Manyung, it seems that the species is either at the extremity of its range, that the environment was not suitable or that the competition from other species of the genus was too intense for it to be adequately established.

The species is distinguished by the ripple-like appearance of the penultimate whorl and by the presence of sharp nodules anterior to the keel on the spire whorls.

Serratifusus archimedes sp. nov.

(Pl. 5, fig. 94-97)

DIAGNOSIS: A *Serratifusus* with almost smooth slightly convex whorls and angular whorl profile. Anterior whorl slope attenuating rapidly from the keel to the suture so that each whorl has the appearance of an inverted cone.

DESCRIPTION: Spire pagodiform with well shouldered whorls which taper rapidly from the keel to the suture. Posterior whorl slope slightly convex near the suture, but depressed near the keel and bearing two or three almost obsolete spiral threads. Keel with numerous small triangular spikes. Anterior whorl slope very slightly convex with about 10-15 spiral threads which continue onto the canal. Aperture subtriangular with weakly developed denticles on the outer lip.

DIMENSIONS:

Holotype	P26496	L 45	LS 23	HA 10	W 17
Paratype	P26497	47	26	11	19

LOCATION OF TYPES: National Museum of Victoria: Holotype P26496, Paratype P26497, both from F. A. Cudmore Collection.

TYPE LOCALITY: Lower beds, Grices Creek (probably equivalent to beds 8 B e, f and g of Gostin (see appendix), downstream section Grices Creek, Grid Ref. Cranbourne 111,910. Balcombe Clay, Bairnsdalian.

STRATIGRAPHIC RANGE: Bairnsdalian—Middle Miocene.

Occurrence: Upper Balcombe Clay: Type locality; Bed beneath Baxter Sandstone at Manyung Rocks, Cranbourne 106,903; Grices Creek, horizon not known.

Material: Types and eight adult specimens from Grices Creek, horizon not known.

Comments: The development of this unusual species can be traced from *S. craspedotus* (Tate) as some specimens of that species from Muddy Creek have the spiral sculpture reduced and the whorls somewhat flattened. However no specimens have yet been found which connect *S. archimedes* sp. nov. with the upstream Grices Creek population of *S. craspedotus*, as there is a covered interval between the upstream and downstream sections at Grices Creek, thus the existence of intermediate forms in the Port Phillip area cannot be proved.

The prominent shoulder on the whorls and the rapid attenuation of the whorls from keel to suture resembles *S. clydoniatus* sp. nov. but this species lacks the nodules beneath the keel.

Apparently *S. archimedes* ranges from low in the Grices Creek section to the top of the Balcombe Clay, but no specimens have been collected in the last few years from the middle and upper part of the Grices Creek section. The specimen from Manyung Rocks is unique despite the fact that extensive collections from that area have been made.

Serratifusus stellatus sp. nov.

(Pl. 5, fig. 82, 86, 93)

Diagnosis: An elongate fusiform *Serratifusus* with somewhat shouldered whorls. Posterior whorl slope convex to concave bearing fine spiral threadlets. Anterior whorl slope of body whorl with coarser close-set threads of which one or two, coincident with the suture, are slightly stronger.

Description: Shell elongate, fusiform, with a gradate spire bearing axial ribs on the first 3½ adult whorls. Posterior whorl slope convex to concave with numerous fine spiral threads. Anterior whorl slope of body whorl convex with 15-20 lirae, of which the median two or three are coarser. Aperture subtriangular to subquadrate, outer lip denticulate. Canal long and twisted with numerous fine lirae and two or three prominent scaly lirae.

Dimensions:

Holotype P26499	L 38	LS 21	HA 9	W 12	
Paratype P26501	33	18	7·5	8·5	Bed 8 B g

Location of Types: National Museum of Victoria: Holotype P26499, F. A. Cudmore Collection; Paratype P26501, Collected T. A. Darragh.

Type Locality: Lower beds, Grices Creek, approximately equivalent to beds 8 B e, f and g of Gostin, the lowest beds exposed in the downstream section. Balcombe Clay, Bairnsdalian, Middle Miocene.

Stratigraphic Range: Bairnsdalian, Middle Miocene.

Occurrence: Balcombe Clay: Lower and Middle beds, Grices Creek; Beds c, d, e, f, g, of Gostin, downstream section Grices Creek, Grid Ref. Cranbourne 111,910; Cliff Section S. of Manyung Rocks, Cranbourne 106,903 (Very rare).

Fyansford Clay: Cliff, left (N.) bank Barwon R., Section IV A, Parish of Murghebolue, Geelong 229,982; ? Orphanage Hill, Fyansford.

Bullenmerri Clay: Allotment 1, Section III, Parish of Colongulac; NW. side, waters edge, Lake Bullenmerri, Camperdown; Lake Gnotuk, Camperdown.

Material: Types, about 15 topotypes and numerous other specimens.

Comments: This is a somewhat variable species in terms of development of the keel spikes since these can be relatively insignificant, or extremely well developed, giving the shell a stellate outline when viewed along the axis. Some specimens also have a slightly scabrose appearance due to the growth striae being raised into minute scales on the spiral lirae.

Its ancestor is probably *S. craspedotus* (Tate) as shown by the rather variable population of Muddy Creek. Why the latter should give rise to two species i.e. *S. stellatus* and *S. archimedes*, both of which occur in the same beds, is not clear, and suggests that the development of these two Bairnsdalian species is more complicated than a simple development from *S. craspedotus*.

Serratifusus squamulatus sp. nov.

(Pl. 5, fig. 80-81, 83, 91)

Diagnosis: A narrow fusiform *Serratifusus* with convex whorls bearing squamose lirae, two to four above the keel and four to six below it.

Description: Shell elongate, fusiform with very convex whorls, sutures impressed. Protoconch with 2-3 axial plicae followed on the first two adult whorls by strong axial ribs which give rise to nodules on the keel. Posterior whorl slope with 2-4 lirae. Anterior whorl slope with 6-8 lirae of which 3-4 are visible on the penultimate whorl. Prominent scales are developed where the growth striae cross the lirae. Aperture elliptical with the inner lip covered with light callus, and with the outer lip faintly denticulate within. Canal almost straight and bearing spiral threads of which 2 or 3 are more prominent and bear scales.

Dimensions:

Holotype	P26503	L 37	LS 22	HA 8	W 12
Paratype	P26505	38	22	7·5	11

Location of Types: National Museum of Victoria: Holotype P26503, Collected T. A. Darragh; Paratype P26505, F. A. Cudmore Collection.

Type Locality: Cliff section to the S. of Manyung Rocks and N. of the jetty and sewer pipe, bed 10 B a of Gostin 1966, Grid Ref. Cranbourne 106,903. Upper Balcombe Clay. Bairnsdalian.

Stratigraphic Range: Bairnsdalian, Middle Miocene.

Occurrence: Type locality. Mouth of Grices Creek, outside fence, upper beds 8 B a and b of Gostin (appendix), Grid Ref. Cranbourne 111,910.

Material: Type specimens and 50 topotypes.

Comments: This species resembles *Hispidofusus senticosus* (Tate) particularly in the development of the adult whorls but differs in having scales rather than hollow spines on the lirae. The protoconch also is typical of *Serratifusus* and is not differentiated from the juvenile whorls as is the case with *Hispidofusus*. The latter also has a more prominently denticulated outer lip and the inner lip is frequently developed into a lamina as in *Columbarium*.

The species displaces *S. stellatus* which is still present at Manyung Rocks, but in considerably reduced numbers.

Fulgurofusus Grabau 1904

Fulgurofusus Grabau 1904, *Smithson. misc. Collns.* 44 (1417): 86; Wenz 1941, *Gastropoda* 1 (5): 1086; Shimer and Shrock 1944, *Index Fossils of North America* p. 507.

Type Species: (Original Designation): *Fusus quercollis* Harris 1896.

Description: Shell fusiform, shouldered with a prominent keel. Protoconch of about 1½ whorls, the first deviated at about 45° to the axis of the shell, the second with a median nodulate keel which merges imperceptibly with the spire whorls. Keel on adult whorls bearing short triangular serrations or developed into a flange. Whorls sculptured with numerous, usually fine lirae. Axial sculpture of growth striae only. Aperture with the inner lip covered with a thin glaze. Canal long and straight.

Stratigraphic Range: Paleocene-Eocene; Recent.

Distribution: Eastern and western N. America; Caribbean; Brazil; South Orkney Is.; New Zealand.

Comments: The protoconch of *Fulgurofusus* is not unlike that of *Columbarium*; however, the former lacks the curved lamina of the columella of *Columbarium*, and also lacks the anterior carina.

The five living species have been placed in *Fulgurofusus* on the basis of the overall shape of the whorls and lack of spines and spiral sculpture. It is realized that there are a few slight differences between the protoconch of *F. quercollis* (Harris) and *F. bermudezi* (Clench and Aguayo) but no more than between the various species of *Columbarium*. The living species have no close affinity with any other living or fossil group of columbariids except the Paleocene *F. quercollis* and the Eocene *F. merriami* and *F. washingtonianus*. At the present time there are no species known to the author which link the living species with the Eocene. The only other similar fossil columbariids are the various species of *Coluzea* from the New Zealand Tertiary, but these have prominent spiral and axial sculpture and a keeled protoconch.

Fulgurofusus quercollis (Harris 1896)

(Pl. 2, fig. 16-18; Fig. 4)

Fusus quercollis Harris 1896, *Bull. Am. Paleont.* 1 (4): 200; Pl. 18, fig. 9.

Fulgurofusus quercollis Grabau 1904, *Smithson. misc. Collns.* 44 (1417): 86; Pl. 17, fig. 6; Fig. 9.

Diagnosis: A *Fulgurofusus* with a double keel on the early whorls, posterior whorl slope smooth, anterior slope of body whorl with about five lirae.

Description: Shell narrowly elongate with a small smooth paucispiral deviated protoconch of about 1½ whorls of which the last half is strongly keeled and bears sharp axial riblets. Protoconch not distinctly separated from the spire whorls. Early spire whorls with a median double keel which is strongly nodulate. Anterior cord of the keel less prominent from about the fifth spire whorl and developing into a narrow lira immediately anterior to the keel. Keel on the body whorl bearing about 15 rounded laminate projections. Posterior whorl slope smooth; anterior whorl slope with three lirae visible on the penultimate whorl and five on the body whorl. Aperture subtriangular. Canal straight with faint traces of spiral threads.

Dimensions:

Hypotype ANSP 9019	L 27·5	LS 16	HA 5 (approx.)	W 7·5
Hypotype USNM 645887	17	—	—	10 (approx.)

LOCATION OF TYPES: Palaeontological Research Institution, Ithaca, New York: Holotype No. 102; Academy of Natural Sciences of Philadelphia: Hypotype 9019; United States National Museum: Hypotype 645887, Hypotype 645888.

TYPE LOCALITY: 1 mile W. of Oak Hill Post Office, Wilcox County, Alabama, U.S.A. Naheola Formation, Upper Midway Group. Upper Paleocene.

STRATIGRAPHIC RANGE: Mathews Landing Member, Porters Creek Clay; Naheola Formation. Paleocene.

OCCURRENCE: Type locality. Mathew's Landing, Wilcox County, Ala., U.S.A. Graveyard Hill, Wilcox County, Ala. Near Rosebud Post Office, Wilcox County, Ala. ½ mile N. of Ripley, Tippah County, Mississippi, U.S.A.

MATERIAL: ANSP 9019, 8524.

COMMENTS: The double keel on the early whorls of this species is quite characteristic and does not occur on any other columbariid of similar shape.

Fulgurofusus merriami (Dickerson 1916)

Fusinus merriami Dickerson 1916, *Univ. Calif. Publs. Bull. Dep. Geol.* 9 (17): 493; Pl. 40, fig. 2a, b.
Fusinus merriami Turner 1938, *Spec. Pap. geol. Soc. Am.* 10: 75; Pl. 17, fig. 8.

DIAGNOSIS: A *Fulgurofusus* with numerous lirae on posterior and anterior whorl slopes, keel serratures posteriorly directed and keel bisecting spire whorls.

DESCRIPTION: Shell elongate with a gradate spire cut by a median serrate keel with posteriorly directed serratures. Posterior whorl slope concave with seven to ten lirae. Anterior whorl slope with eight lirae, three of which are more prominent, the anterior of these coincident with the posterior suture of the body whorl.

DIMENSIONS:

Lectotype	11833	L 25	LS 16	HA 6	W 8

LOCATION OF TYPES: University of California, Berkeley: Lectotype 11833, Collected R. E. Dickerson; Paratype 11832.

TYPE LOCALITY: UC 1853 Marysville Buttes, 2½ miles W., 10°N. of South Butte in small canyon E. of County road, Sutter County. Marysville Buttes quadrangle, N ½ 28, T 16 N, R 1E. California, U.S.A. Capay Formation, Lower Eocene.

STRATIGRAPHIC RANGE: Lower-Middle (?) Eocene.

OCCURRENCE: California, type locality, UC 1428, CAS 259. Western Oregon UCA 691 Lower Umpqua Formation, Lower Eocene. UCA 685 ? Tyee Formation, Middle Eocene. UCA 1135 Lower Umpqua Formation.

MATERIAL: Syntypes.

COMMENTS: This species has a suggestion of a double keel as in *F. quercollis* but has much more radial and spiral sculpture. It connects *F. quercollis* with *F. washingtonianus* Weaver. The protoconch is similar to that of *F. bermudezi.*

Fulgurofusus washingtonianus (Weaver 1912)

Fusus washingtoniana Weaver 1912, *Bull. Wash. geol. Surv.* 15: 50; Pl. 2, fig. 10; Dickerson 1915, *Proc. Calif. Acad. Sci.* ser. 4, 5: 72; Pl. 9, fig. 8.
Fulgurofusus washingtoniana Weaver 1943, *Univ. Wash. Publs. Geol.* 5 (ii): 490; Pl. 93, fig. 12, 16, 17; Pl. 101, fig. 4, 5.

DIAGNOSIS: A *Fulgurofusus* with numerous lirae on the posterior whorl slope and with the anterior suture immediately in front of the keel.

DESCRIPTION: Shell fusiform with a sub-conical spire having a serrate keel situate immediately behind the anterior suture. Early spire whorls with incipient costae coincident with the keel serratures. Posterior whorl slope subconcave, prominent and bearing numerous somewhat undulose lirae. Anterior whorl slope of spire, flat, almost horizontal, hidden by over-hang of the keel and bearing two prominent lirae. Anterior slope of body whorl with a cord coincident with the posterior suture and alternate stout and thin lirae which extend onto the straight canal.

DIMENSIONS:

Holotype CAS 7559	L 25	W 13	(Weaver)

LOCATION OF TYPES: California Academy of Sciences: Holotype CAS 7559; Paratype CAS 497.

TYPE LOCALITY: North bank of Cowlitz R., 1½ miles E. of Vader, Section 28, T. 11N., R. 2W., Lewis County, Washington, U.S.A. Cowlitz Formation, Upper Eocene.

STRATIGRAPHIC RANGE: Cowlitz Formation, Upper Eocene.

OCCURRENCE: Type locality and environs.

MATERIAL: One broken topotype.

COMMENTS: The much reduced anterior whorl slope of the spire distinguishes this species from others in the genus. In morphology it seems to connect *F. merriami* with *F. bermudezi* (Clench and Aguayo).

Fulgurofusus bermudezi (Clench and Aguayo 1938)

(Pl. 6, fig. 120-121, 128; Fig. 5)

Columbarium bermudezi Clench and Aguayo 1938, *Mems. Soc. cub. Hist. nat.* 12 (5): 383; Pl. 28, fig. 7; Clench 1944, *Johnsonia* 1 (15): 2; Pl. 1, fig. 3.

DIAGNOSIS: An elongate *Fulgurofusus* with a single keel on the juvenile whorls; posterior whorl slope flat and smooth; anterior whorl slope of body whorl flat to gently concave, smooth or with one lira and a few incipient spiral threads.

DESCRIPTION: Shell elongate with smooth spire whorls cut by a single median keel bearing anteriorly directed lobate projections. Protoconch deviated paucispiral of about 1½ whorls, smooth, imperceptibly passing into the spire whorls. Nodulate keel developing on the second whorl. Posterior whorl slope of body whorl smooth; anterior whorl slope smooth on some specimens, but on others with a single lira and spiral threads. Aperture subquadrate. Canal long and straight with incipient spiral threads.

DIMENSIONS:

	L	LS	HA	W
Holotype MCZ 135007	27·5	13·5		
Paratype MCZ 135008	25	14	4·5	6·5
Hypotype MCZ 135169	30·5	16·5	3·5	8

LOCATION OF TYPES: Museum of Comparative Zoology, Harvard University: Holotype MCZ 135007; Paratype MCZ 135008; Hypotype MCZ 135169. Museo Poey, Habana, Cuba: Paratype.

Type Locality: *Atlantis* Station No. 2989, Lat. 23°10′N.; Long. 80°4′W. off Sagua la Grande, Santa Clara, Cuba, 360 fathoms.

Occurrence: *Atlantis* Station No. 2988, Lat. 23°15′N.; Long. 79°57′W., 380 fathoms off Sagua la Grande, Cuba. MCZ 135008. Station No. 2981D, Lat. 22°48′ N., Long. 78°51′W., 190-230 fathoms off Punta Alegre, Camaguey, Cuba. MCZ 135049. Station No. 3427, Lat. 22°52′30″N.; Long. 79°20′W., 240 fathoms off Caibarién, Santa Clara, Cuba.

Material: 3 specimens.

Comments: This species has considerable affinity with *F. sarissophorus* (Watson) but is much narrower and more elongate and has the projections of the keel directed anteriorly rather than laterally as in the former.

Fulgurofusus sarissophorus (Watson 1882)

(Pl. 6, fig. 107, 112)

Fusus (Colus) sarissophorus Watson 1882, *J. Linn. Soc.* Zoology 16: 382.
Fusus sarissophorus Watson 1886, *Challenger Report* Zoology 15 (42): 196; Pl. 14, fig. 1.
Columbarium sarissophorum Clench 1944, *Johnsonia* 1 (15): 1; Pl. 1, fig. 1.

Diagnosis: A fusiform *Fulgurofusus* with a conical spire, anterior and posterior whorl slopes bearing fine spiral threads; canal long and straight.

Description: Shell fusiform with a conical spire. Spire whorls slightly convex and cut by a serrate keel just posterior to the anterior suture. Keel on body whorl median. Anterior and posterior whorl slopes of the body whorl convex, bearing fine spiral threads which continue on the canal. Aperture subtriangular.

Dimensions:

Holotype	L 19	LS 9·5	HA 3·5	W 6

Location of Type: British Museum (Natural History): BM(NH) 1887.2.9. 687.

Type Locality: *Challenger* Station 122, 10.9.1873, Lat 9°5′S., Long. 34°50′ W., 350 fathoms, off Pernambuco, Brazil.

Material: Photographs of the holotype, the only specimen known. Measurements supplied by Dr N. H. Tebble.

Comments: The species is related to *Fulgurofusus bermudezi* (Clench and Aguayo) as outlined under that species. The smooth whorls and squat conical spire distinguish this species from others in the genus.

Fulgurofusus brayi (Clench 1959)

(Pl. 6, fig. 113, 115)

Columbarium brayi Clench 1959, *Johnsonia* 3 (39): 330; Pl. 173, fig. 1, 2.

Diagnosis: A clavate *Fulgurofusus* with a depressed spire and sharply keeled whorls. Posterior whorl slope smooth and convex; flanged keel with about five fine spiral threads on the posterior surface. Anterior whorl slope convex with numerous fine spiral threads which continue from the anterior side of the flange onto the canal.

Description: Protoconch deviated paucispiral of 1 to 1½ whorls. Spire whorls bisected by a prominent laminar keel which bears fine spiral threads on its anterior and posterior surfaces. Posterior whorl slope convex and smooth; anterior whorl slope of body whorl with numerous crowded fine spiral threads which are continuous from the keel on to the canal. Aperture subtriangular. Canal long and slightly twisted.

DIMENSIONS:

Holotype	MCZ 221601	L 51	LS —	HA —	W —
Paratype	MCZ 221602	38	17	7	13

LOCATION OF TYPES: Museum of Comparative Zoology: Holotype MCZ 221601; Paratype MCZ 221602.

TYPE LOCALITY: *Atlantis* Station Lat. 11°N., Long. 66°1′ off Cabo Codera, Venezuela, 150 fathoms.

OCCURRENCE: Type Locality.

MATERIAL: Paratype.

COMMENTS: The more prominent sharp keel and fine spiral sculpture separate this species from *F. benthocallis* (Melvill and Standen), the only other columbariid which resembles it.

Fulgurofusus benthocallis (Melvill and Standen 1907)

(Pl. 6, fig. 118, 124)

Columbarium benthocallis Melvill and Standen 1907, *Trans. R. Soc. Edinb.* 46 (1): 140; Pl., fig. 11.

DIAGNOSIS: An elongate *Fulgurofusus* with a flangelike keel; posterior whorl slope ornamented with very fine spiral threads; anterior whorl slope of body whorl with numerous fine spiral threads and thin rather prominent median lira.

DESCRIPTION: Shell gradate with shouldered whorls bearing a prominent flanged keel. Posterior whorl slope flat, with very fine spiral threads which are also present on the flanged keel. Anterior whorl slope with somewhat coarser spiral threads and on the body whorl a prominent median lira which is contiguous with the suture. Aperture subquadrate. Canal long and straight. Growth lines somewhat coarser on the early whorls giving a rather cancellate appearance to the surface of the shell.

DIMENSIONS:

Holotype	L 42	LS 24	HA 9	W 14	Apex of shell eroded

LOCATION OF TYPE: Royal Scottish Museum: Holotype 1921.143.673, W. S. Bruce Collection.

TYPE LOCALITY: Scottish National Antarctic Expedition *Scotia* Station 313, 10.3.1903, Trawl. Lat. 62°10′S.; Long. 41°20′W. 1755 fathoms. South Orkney Islands.

OCCURRENCE: Type locality.

MATERIAL: Holotype, the only specimen known.

COMMENTS: The only other named species which approaches *F. benthocallis* is *F. brayi* (Clench) which has a very low spire, a much more prominent keel and lacks the prominent lira of the body whorl. These two species which are closely related are provisionally placed in *Fulgurofusus* on the grounds of their general similarity to *F. bermudezi* (Clench and Aguayo) which, whilst having a serrate keel, has a similar whorl shape, ornament, a long straight canal and a simple inner lip. An unnamed species similar in appearance to *F. benthocallis* is discussed below.

Fulgurofusus sp. cf. **benthocallis** (Melvill and Standen 1907)

(Pl. 6, fig. 114)

COMMENTS: A single specimen from New Zealand Oceanographic Station E749/TAM, 40°47′S., 176°57′E.; 499-545 fathoms, off Castle Point, North Island, New Zealand, is very similar to *F. benthocallis* in sculpture, as both anterior and posterior whorl slopes bear fine spiral threads with a single prominent lira on the anterior whorl slope, but the flange is directed anteriorly rather than posteriorly and the outline of the body whorl is not as rectangular and is more in accord with *F. brayi* (Clench).

Unfortunately the specimen is a dead shell with the protoconch missing, so it is not possible to determine the relationship of it or its relatives to the other New Zealand columbariids, and at the time of writing the shell is missing.

Coluzea Finlay 1927

Coluzea Finlay in Allan 1927, *Trans. N.Z. Inst.* 57: 304; Finlay 1927, *Ibid.* p. 407; Finlay 1930, *Ibid.* 61: 267; Dell 1956, *Rec. Dom. Mus. Wellington* 3 (1): 47.

TYPE SPECIES: (Monotypy): *Fusus dentatus* Hutton 1877.

DESCRIPTION: Shell elongate, fusiform with regularly convex whorls cut by a prominent keel. Protoconch of 1½ to 2½ whorls, usually keeled, the first usually larger than the remainder, deviated at a low angle to the axis of the spire and flattened, second whorl either merging gradually with the spire whorls or ending abruptly, sometimes with a small varix or midwhorl nodule. Spire whorls convex, sculptured with prominent spiral lirae and often broad low axial ribs or folds. Keel prominent, rarely obsolete, occasionally produced into a flange but usually in the form of flattened blunt triangular projections. Aperture subtriangular with the inner lip coated with a thin glaze. Canal long and straight or very slightly twisted.

STRATIGRAPHIC RANGE: Middle Eocene, Lower Oligocene, Europe; Lower Oligocene—Recent, New Zealand; Recent, Africa.

DISTRIBUTION: Europe, New Zealand, South Africa, West Africa.

COMMENTS: The protoconch of *Coluzea* is somewhat variable from species to species when compared with other columbariids, though most seem to be of the form of *C. dentata* (Hutton) rather than *C. spiralis* (A. Adams). The latter has a prominently keeled protoconch (Fig. 13) which merges gradually with the spire whorls, unlike most of the other species, which either end abruptly as in *C. mariae* Powell (Fig. 11) or end in an incipient varix or small ribs as in *C. dentata* (Hutton) (Fig. 7). *C. climacota* (Suter) is not a columbariid since the protoconch is rather different from all the others in having more whorls and a more prominent midwhorl keel which spirals to the anterior suture and forms the sutural lira, whilst another midwhorl keel develops from a series of small midwhorl nodules.

The South African species described below were originally thought to be related to the Australian *Serratifusus* but on examination of specimens now in hand it appears that their affinities are more with *Coluzea*. They lack the prominent triangular keel spikes of the former and also the prominent axial plicae of the protoconch, though the specimens examined are worn. Moreover, they lack the prominent axial costae of the early spire whorls which is so typical of *Serratifusus*. The radulae and opercula of the four species are typical of the family.

The authorship and type species of *Coluzea* is in dispute due to an inadvertent appearance of the name in a list prior to the original description, and the settlement of this problem will probably be a matter for the International Commission on Zoological Nomenclature. Fortunately the existence of this problem does not affect the concept of the genus, as both 'type' species are very similar in morphology and are closely related.

A detailed treatment of the genus and its species is not contemplated, but a list of the New Zealand species proposed by various authors and their time ranges is given below. Dr Alan Beu of the New Zealand Geological Survey kindly supplied most of the data. More details of the fossil species of *Coluzea* may be found in Finlay 1930, and of the living species in Dell 1956.

C. maorium (Marshall and Murdoch 1919) Duntroonian (Upper Oligocene).
C. dentata (Hutton 1877) Waitakian—Waiauan (Lower—Upper Miocene).
C. paucispinosa Finlay 1930 Waitakian (Lower Miocene).
C. macrior Finlay 1930 Awamoan (Lower Miocene).
C. kiosk Finlay 1930 Altonian—Clifdenian (Middle Miocene).
C. spectabilis Powell 1931 Kapitean-Waipipian (Upper Miocene-Middle Pliocene).
C. mariae Powell 1952 Waipipian (Middle Pliocene)—Recent.
C. espinosa Finlay 1930 Nukumaruan (Lower Pleistocene).
C. spiralis A. Adams, 1856 Castlecliffian (Lower Pleistocene)—Recent.
C. altocanalis Dell 1956. Recent.

Coluzea serrata (Deshayes 1825)

(Fig. 6)

Fusus serratus Deshayes 1825, *Dict. Class. d'Hist. Nat.* 7: 89; 1831, *Ibid.* vol. 17: 119; Pl. 80, fig. 3; 1835, *Coquille Foss. Paris* 2: 513; Pl. 73, fig. 12-13.
Fusus unicarinatus J. de C. Sowerby in Dixon 1852, *Geology of Sussex* p. 104; Pl. 7, fig. 25, non Deshayes 1825.
Fusus serratus Deshayes 1865, *Desc. Anim. s. Vert. du Bassin de Paris* 3: 253; Cossmann 1889, *Annls. Soc. r. malacol. Belg.* 24: 178.
Falisfusus (?) serratus Gradau 1904, *Smithson, Misc. Collns.* 44 (1417): 84; Pl. 1, fig. 9, 10, 14.
Fusus serratus Cossmann & Pissarro 1911, *Icon. Coq. Foss. Eoc. Paris*; Pl. 41, fig. 201-4.
Fusinus serratus Wrigley 1927, *Proc. malac. Soc. Lond.* 17 (5 & 6): 219.

DIAGNOSIS: A narrowly elongate *Coluzea* with early spire whorls costate and regularly convex. Adult whorls not costate but cut by a serrate keel and with three lirae on the posterior whorl slope and five or six on the anterior whorl slope of the body whorl.

DESCRIPTION: Protoconch small, of about 2½ whorls, the first deviated slightly from the axis of the shell and swollen, the second smooth, swollen at the midwhorl, then flat and merging imperceptibly into the spire whorls which have rather vague axial costae. Axial costae prominent from the third whorl but diminish so that they are almost obsolete on the final two or three whorls. Juvenile spire whorls convex and cancellate. Adult whorls with a prominent serrate keel, a flat posterior whorl slope bearing three fine lirae and an anterior whorl slope on the body whorl with five or six lirae one of which is present on the spire whorls. Canal long, straight and bearing numerous fine spiral threads.

DIMENSIONS:

Holotype		L 100	LS —	HA —	W —
Hypotype	P26535	46	33	9	13

LOCATION OF TYPE: Ecole des Mines, Paris: Holotype; National Museum of Victoria: Hypotype P26535, G. P. Deshayes Collection v/1863.

TYPE LOCALITY: Parnes, Oise, France. Calcaire Grossier Lutetian.

STRATIGRAPHIC RANGE: Lutetian-Auversian, Middle Eocene.

OCCURRENCE: Calcaire Grossier: (Lutetian) Parnes, Grignon, Mouchy, Damery; Paris Basin, France.

Upper Bracklesham beds: (Auversian) Bracklesham, Sussex, England; Stubington, Hampshire, England.

MATERIAL: One specimen P26535 identified by Deshayes.

COMMENTS: Dunker (1882, p. 13) has drawn attention to the similarity between this species and *Columbarium pagoda* (Lesson), and Briart and Cornet (1880) stated that their *Fusus heberti* belonged in the same group as *Fusus serratus*. Grabau (1904, p. 85) after doubtfully referring the species to his genus *Falsifusus* pointed out the differences in the protoconch from that of the type species of that genus. His description of protoconch and shell is excellent. The overall similarity of shell and protoconch of *Fusus serratus* to *Coluzea dentata* (Hutton) is striking and this, coupled with its lack of features typical of *Columbarium* would seem to indicate that it is a true *Coluzea*, and in fact, it is the earliest representative of the genus known.

There is a closely related species in the Lower Oligocene of North Germany, *Fusus multispiratus* von Koenan 1889 (p. 174, Pl. 14, fig. 5, 6) which indicates that the European lineage of *Coluzea* was well established before that of New Zealand.

The writer is unable to express an opinion on the correct generic position of *Fusus unicarinatus* Deshayes from the French and English Eocene (Wrigley 1927, p. 217) as there are no specimens available for examination. Judging from figures this species seems to have affinity with *Coluzea serrata.*

Coluzea radialis (Watson 1882)

(Pl. 6, fig. 109-110, 117, 123)

Fusus (Colus) radialis Watson 1882, *J. Linn. Soc.* Zoology 16: 382.
Fusus radialis Watson 1886, *Challenger Report* Zoology 15 (42): 195; Pl. 14, fig. 2.
Columbarium radiale Barnard 1959, *Ann. S. Afr. Mus.* 45 (1): 234; Fig. 52 (a), (b), (e).

DIAGNOSIS: An elongate *Coluzea* with a high spire of regularly convex whorls cut by a median serrate keel. Posterior whorl slope with two prominent spiral cords, but on some specimens there are up to six. Anterior whorl slope of body whorl with four to eight spiral cords.

DESCRIPTION: Shell fusiform with a high spire of regularly convex whorls bisected by a keel bearing triangular serrations. Early whorls ribbed axially with the ribs fading on about the seventh whorl. Posterior whorl slope with four to six prominent spiral cords; anterior whorl slope of spire whorls with one to three cords, on body whorl from four to six cords. Aperture semicircular. Canal long and straight. Operculum pyriform tapering rapidly to an acute nuclear apex.

DIMENSIONS:

Holotype	BM(NH) 1887.2.9.686	L 35	HA 8	W 15	Apex eroded
Hypotype	SAM A4617	44	8·5	13·5	Apex eroded
	SAM 6394	55	12	19	Apex eroded

Location of Types: British Museum (Natural History): Holotype BM(NH) 1887.2.9.686; South African Museum: Hypotype SAM A4617.

Type Locality: *Challenger* Station 142, Lat. 35°4′S.; Long. 18°37′E. off the Cape of Good Hope, South Africa, 150 fathoms.

Occurrence: Type locality and environs.

Material: Four specimens SAM A4617, A4616, A6394.

Comments: Of the four specimens examined none had the apex preserved. However Barnard (1959, p. 234) has given a description and figure which matches the protoconch of *Coluzea angularis* (Barnard) which the author has examined. As originally stated by Watson this species bears a considerable resemblance to *Coluzea spiralis* (A. Adams) but apart from the difference in the protoconch the latter has no axial ribs on the early whorls as in *C. radialis*.

Coluzea angularis (Barnard 1959)

(Pl. 6, fig. 125, 127, 129, 131; Fig. 22)

Columbarium angulare Barnard 1959, *Ann. S. Afr. Mus.* 45 (1): 235; Fig. 52 (c).

Diagnosis: An elongate *Coluzea* with a gradate spire of shouldered whorls. Keel scarcely developed and bearing pointed nodules formed by short axial ribs crossing the keel. Spiral sculpture variable in degree of development, consisting of up to five fine lirae on the posterior whorl slope and from four to eight on the anterior slope of the body whorl of which two or three are often more strongly developed.

Description: Shell elongate, subfusiform with a gradate spire of shouldered whorls cut by a median nodulose keel. Protoconch of 1½ to 2 whorls, first whorl deviated. Beginning of adult whorls marked by two or three incipient axial ribs and the development of a keel. Axial ribs on later adult whorls stronger and forming pointed nodules where they cross the keel. Posterior whorl slope concave bearing up to five fine lirae. Anterior whorl slope of body whorl regularly convex with four to eight lirae of which two or three are generally better developed. Aperture subrectangular, inner lip covered only with a thin glaze. Canal long and twisted.

Dimensions:

Holotype SAM A4608	L 51	LS 28	HA 9	W 12·5	Apex missing
Hypotype SAM A4609	34	21	5·5	10	

Location of Types: South African Museum: Holotype SAM A4608, Hypotype SAM A4609, both from Pieter Faure Collection; British Museum (Natural History): Paratype 1962285.

Type Locality: Off Cape Point, South Africa 720-900 fathoms.

Occurrence: Type locality only.

Material: Holotype and two topotypes SAM A3608-3610.

Comments: This species is quite different in appearance from all others of the genus apart from *Coluzea rotunda* (Barnard). However the early spire whorls are very similar to those of *C. radialis* (Watson).

Coluzea rotunda (Barnard 1959)

(Pl. 6, fig. 126, 130)

Columbarium rotundum Barnard 1959, *Ann. S. Afr. Mus.* 45 (1): 236; Fig. 52 (d).

Diagnosis: A fusiform *Coluzea* with strong axial ribs and no keel. Posterior whorl slope slightly concave so that the whorls are scarcely shouldered. Posterior whorl slope bearing about eight irregularly spaced fine spiral threads of varying strength. Anterior whorl slope with three or four spiral cords and numerous finer lirae.

Description: Shell with early whorls shouldered and bearing strong axial costae which together with the shoulder diminish in strength on the body whorl. Posterior whorl slope slightly concave on the spire whorls but becoming convex on the body whorl so that this is almost regularly convex. Posterior whorl slope of body whorl with up to eight irregularly spaced fine threads. Anterior whorl slope with three or four spiral cords and numerous finer lirae which persist on the canal. Aperture subcircular. Inner lip covered with a thin glaze. Canal short and twisted.

Dimensions:

Holotype	SAM A4592	L 75	LS —	HA —	W 25	Apex missing
Hypotype	SAM	64	40	13·5	19·5	Apex missing
	SAM A4607	69	43	13·5	20	

Location of Types: South African Museum: Holotype SAM A4592, Pieter Faure Collection; Hypotype. British Museum (Natural History): Paratype 1962 286.

Type Locality: Off Cape Point, South Africa. 250-760 fathoms.

Occurrence: Type locality only.

Material: Hypotype and three topotypes.

Comments: It is possible that a good series of specimens would show that this species is not distinct from *Coluzea angularis* (Barnard). The early spire whorls are similar, the sculpture is similar and the distinguishing feature *viz.* the tumid, regularly convex body whorl, seems to be variable in both species.

Coluzea cingulata (Martens 1901)

(Pl. 6, fig. 106, 116; Fig. 18)

Columbarium cingulatum Martens 1901, *Sber. Ges. naturf. Freunde Berl.* for 1901, p. 20; Martens 1903, *Deutsche Tiefsee-Expedition 1898-99*, 7 (1): 93; Pl. 2, fig. 8; Thiele 1925, *Ibid.* 17 (2): 167; Pl. 46, fig. 24.

Diagnosis: An elongate *Coluzea* with a prominent median double keel on the angular spire whorls. Posterior whorl slope of body whorl concave with a single prominent lira and a fine thread posterior to it. Anterior whorl slope of body whorl concave beneath the keel, then convex with several fine spiral threads and two or three more prominent lirae which are also present on the canal.

Description: A fusiform shell with a rectangular whorl profile. Protoconch and early whorls a little eroded, but similar to *Coluzea angularis*. Early whorls with a median keel crossed by radial ribs which form sharp nodules at their crossing of the keel. Posterior whorl slope of early whorls with a prominent lira which becomes stronger and forms a second posterior keel on the fifth whorl and which continues on the body whorl where the anterior keel decreases in prominence towards the aperture. Double keel somewhat undulose on the fifth to eighth whorls where it is crossed by radial ribs; these undulations fade on the body whorl. Posterior whorl slope concave with a single lira and a fine spiral thread near the suture. Anterior whorl slope with several fine spiral threads anterior to the keel and with two or three coarser lirae which continue on to the canal. Aperture subrectangular. Inner lip covered with a thin glaze. Canal long, very slightly twisted. Operculum pyriform with an apical nucleus.

DIMENSIONS:

Holotype	61029	L 54	LS 28	HA 7·5	W 14

LOCATION OF TYPE: Institut für Spezielle Zoologie und Zoologisches Museum der Humboldt-Universität zu Berlin: Holotype No. 61029.

TYPE LOCALITY: *Valdivia* Station 246 Pemba Channel 2.3.1899. Long. 5°24′ S.; Lat. 39°19′E. 818 metres. Tanzania, East Africa.

OCCURRENCE: Type locality.

MATERIAL: Holotype, the only specimen known.

COMMENTS: The early whorls are very similar to those of *Coluzea angularis* (Barnard) and *C. radialis* (Watson), but the double keel and angular appearance of the spire whorls are unique in the genus.

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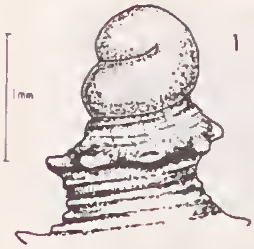
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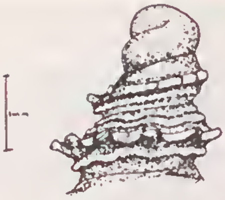
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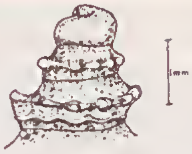
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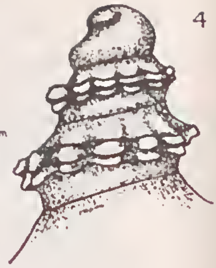
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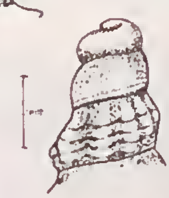
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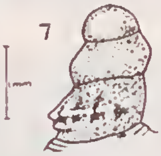
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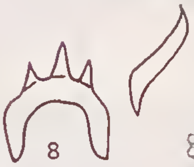
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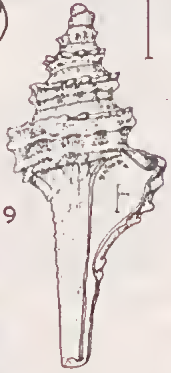
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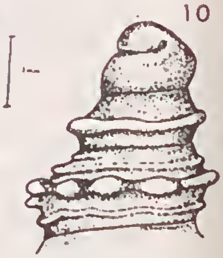
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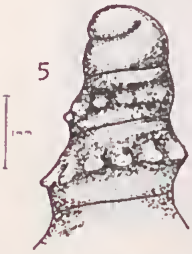
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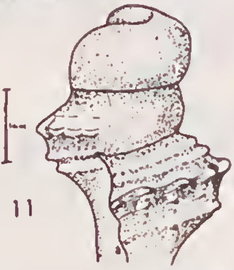
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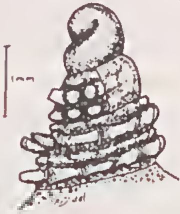
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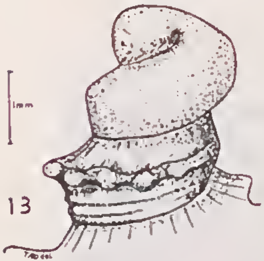
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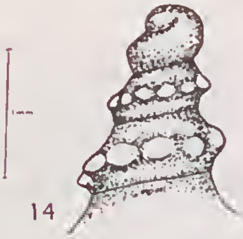
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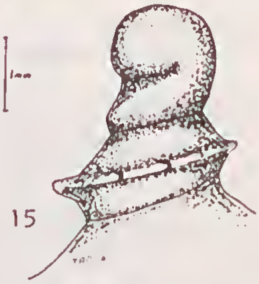
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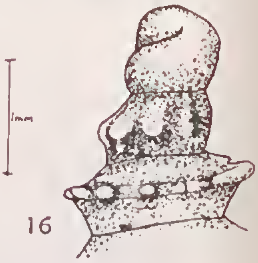
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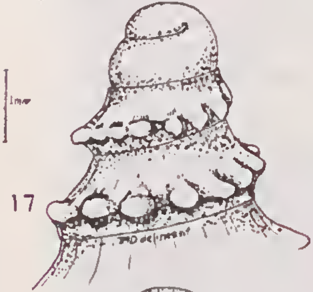
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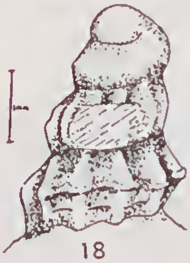
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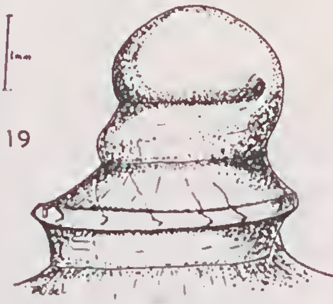
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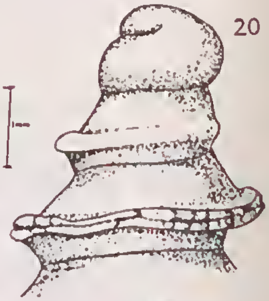
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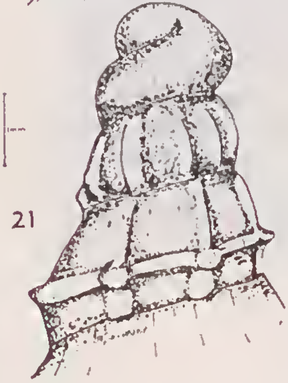
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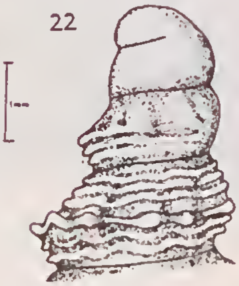
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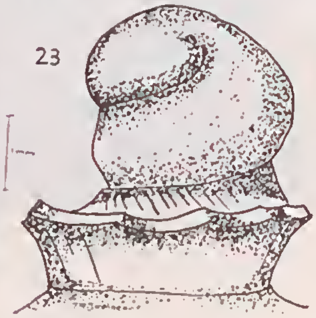
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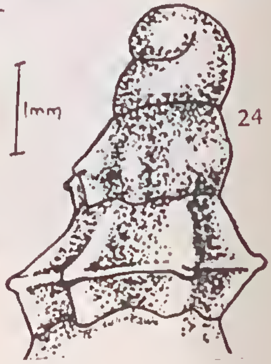
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Fig. 1-24—(1) *Histricosceptrum atlantis* (Clench and Aguayo), MCZ 135170; (2) *Histricosceptrum canaliculatum* (Martens), IZMHUB 61028; (3) *Columbarium heberti* (Briart and Cornet), IRSNB 5333; (4) *Fulgurofusus quercollis* (Harris), ANSP 9019; (5) *Fulgurofusus bermudezi* (Clench and Aguayo), MCZ 135008; (6) *Coluzea serrata* (Deshayes), P26535; (7) *Coluzea dentata* (Hutton), DM M9294, Pukeuri, New Zealand; (8) *Columbarium hedleyi* Iredale, NMV F27080, × 200; (9) *Columbarium heberti* (Briart and Cornet), IRSNB 5333, Mons (Puits Coppée); (10) *Columbarium natalense* Tomlin, SAM A3497; (11) *Coluzea mariae* Powell, DM M11274; (12) *Hispidofusus senticosus* (Tate), P26459; (13) *Coluzea spiralis* (A. Adams), DM M2522; (14) *Columbarium rugatum* Aldrich, ANSP 9018; (15) *Columbarium spinicinctum* (Martens), NMV F26251; (16) *Hispidofusus piscatarius* sp. nov. P26453; (17) *Columbarium cochleatum* (Tate), P26396; (18) *Coluzae cingulata* (Martens), IZMHUB 61029; (19) *Columbarium pagodoides* (Watson), AM C2965; (20) *Columbarium formosissimum* Tomlin, SAM A3500; (21) *Serratifusus craspedotus* (Tate), P26487; (22) *Coluzea angularis* Barnard, SAM A4609; (23) *Columbarium pagoda* (Lesson), NMV F27195; (24) *Serratifusus* (?) *youngi* (Chapman), P13246.

[Sources of material figured, here indicated by initials, are stated fully in text.]

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Appendix furnished by V. A. Gostin

DETAILS* OF SECTION 8B NEAR THE MOUTH OF GRICES CREEK

See map in Gostin 1966, p. 467

Top of section obscured by beach sand.
Concretions.
3 feet clayey silt often partially obscured by sand.
Prominent layer of limestone concretions.
(a) 3 feet clayey silt.
Concretions.
(b) 11 feet clayey silt, fence situated 2 feet above concretion at the base of this bed.
Prominent layer of concretions.
(c) 4 feet clayey silt.
Concretions.
(d) 6 feet clayey silt.
Prominent layer of concretions.
(e) 10 feet clayey silt.
(f) 10 feet clayey silt.
Base of section obscured by soil and debris.

* From Field Notes only. Base and top of section are obscured, and beds have been informally lettered.

Explanation of Plates

Fig. 2-3, 5-9, 11-14, 18, 20-23, 25-27, 29, 32-33, 35, 37, 39-48, 50-57, 60, 66-68, 72, 75, 78-97, 99-102, 104-106, 108-111, 113-116, 118-122, 124-126, 128, 130-131, are from photographs by Mr Frank Guy. Fig. 10, 15-17, 24 are from United States National Museum, photographs. Fig. 4, 19, 28 are from Faculté Polytechnique de Mons photographs. Fig. 1, 30-31, 38, 49, 98, 103 are from Adelaide University Geology Department photographs. Fig. 34-36 are from Muséum d'Histoire Naturelle, Geneva photographs.

Fig. 58, 64 are from Manchester Museum photographs. Fig. 59, 63, 65, 69-71 are from Australian Museum photographs. Fig. 61-62 are from Dominion Museum photographs. Fig. 73, 77 are from Auckland Institute and Museum photographs. Fig. 74, 76, 107, 112, 117, 123, 127, 129 are from British Museum (Natural History) photographs.

Plate 2

Fig. 1—*Hispidofusus senticosus* (Tate), T485A, holotype, Fossil Beach, Mornington, Vict., × 2.

Fig. 2—*Hispidofusus piscatorius* sp. nov., P26455, paratype, Curlewis, Vict., × 1½.

Fig. 3—*Hispidofusus piscatorius* sp. nov., P26453, holotype, Fischers Point, Aire R., Vict., × 1½.

Fig. 4—*Columbarium heberti* (Briart and Cornet), lectoparatype, Mons, Belgium, × 1.

Fig. 5—*Hispidofusus piscatorius* sp. nov., P26453, holotype, × 1½.

Fig. 6-7—*Hispidofusus senticosus* (Tate), P26458, hypotype, Fossil Beach, Mornington, Vict., × 1½.

Fig. 8—*Serratifusus bovarius* sp. nov., P26485, holotype, Ampitheatre, Leigh R., Vict., × 1.

Fig. 9—*Hispidofusus senticosus* (Tate), P26459, hypotype, Fossil Beach, Mornington, Vict., × 2.

Fig. 10—*Columbarium rugatum* (Aldrich), USNM 645889, hypotype, Greggs Landing, Alabama, U.S.A., showing anterior carina and keel; note growth lines arched towards the aperture and raised into scales on the carina, × 3.

Fig. 11—*Serratifusus bovarius* sp. nov., P26485, holotype, × 1.

Fig. 12-13—*Serratifusus bovarius* sp. nov., P26484, paratype, Curlewis, Vict., × 1.

Fig. 14—*Hispidofusus senticosus* (Tate), P26459, hypotype, × 2.

Fig. 15—*Columbarium rugatum* (Aldrich), USNM 638758, holotype, Greggs Landing, Alabama, U.S.A., × 1½.

Fig. 16—*Fulgurofusus quercollis* (Harris), USNM 645888, hypotype, Rosebud P.O., Alabama, U.S.A., × 4.

Fig. 17—*Fulgurofusus quercollis* (Harris), USNM 645887, hypotype, Mathews Landing, Alabama, U.S.A., × 3.

Fig. 18—*Fulgurofusus quercollis* (Harris), ANSP 9019, hypotype, Graveyard Hill, Alabama, U.S.A., × 2.

Fig. 19—*Columbarium heberti* (Briart and Cornet), lectotype, Mons, Belgium, × 1.

Fig. 20—*Columbarium heberti*, IRSNB 3309, hypotype, Mesvin-Belian, Belgium, × 1.

Fig. 21—*Columbarium heberti*, lectoparatype of *Fusus bicinctus* Kaunhowen, Maastricht, Netherlands, × 1.

Fig. 22-23—*Columbarium spinicinctum* (von Martens), IZMHUB 26677, holotype, off Cape Moreton, Qld., × 1.

Fig. 24—*Columbarium rugatum* (Aldrich), USNM 645889, hypotype, × 1½.

Fig. 25—*Columbarium rugatum* (Aldrich), ANSP 6869, hypotype, Greggs Landing, Alabama, USA, × 1.

Fig. 26—*Columbarium heberti*, lectotype of *Fusus bicinctus* Kaunhowen, Netherlands, × 1, × 1.

Fig. 27—*Columbarium heberti*, lectoparatype of *Fusus bicinctus* Kaunhowen, Maastricht, Netherlands, × 1.

Fig. 28—*Columbarium heberti*, lectotype, × 3.

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Fig. 29—*Columbarium calcaratum* sp. nov., P26461, holotype, Point Flinders, Vict., × 1.

Fig. 30—*Columbarium cochleatum* (Tate), T 484B, holotype, Aldinga, S.A., × 1.

Fig. 31—*Columbarium spinulatum* Cossmann, T 476B, holotype, R. Murray 4 miles below Morgan, S.A., × 1.

Fig. 32—*Columbarium acanthostephes vulsum* subsp. nov., P26477, paratype, Manyung Rocks, Vict., × 1.

Fig. 33—*Columbarium calcaratum* sp. nov., P26463, paratype, Point Flinders, Vict., × 1.
Fig. 34—*Columbarium pagoda* (Lesson), MHNG 1108/7, holotype, ? (Japan), × 1.
Fig. 35—*Columbarium acanthostephes vulsum* subsp. nov., P26477, paratype, × 1.
Fig. 36—*Columbarium pagoda* (Lesson), MHNG 1108/7, holotype, × 1.
Fig. 37—*Columbarium uniliratum* sp. nov., P26464, holotype, Bird Rock cliffs, Vict., × 1½.
Fig. 38—*Columbarium cochleatum* (Tate), T 484C, hypotype, Aldinga, S.A., × 1.
Fig. 39—*Columbarium calcaratum* sp. nov., P26461, holotype, × 1.
Fig. 40—*Columbarium acanthostephes vulsum* subsp. nov., P26475, holotype, Grices Creek, Vict., × 1.
Fig. 41—*Columbarium acanthostephes echinatum* subsp. nov., P26470, paratype, Fossil Bluff, Tas., × 1.
Fig. 42—*Columbarium uniliratum* sp. nov., P26464, holotype, × 1½.
Fig. 43—*Columbarium uniliratum* sp. nov., P26466, paratype, Bird Rock cliffs, Vict., × 1.
Fig. 44—*Columbarium acanthostephes echinatum* subsp. nov., P26470, paratype, × 1.
Fig. 45—*Columbarium uniliratum* sp. nov., P26465, paratype, Bird Rock cliffs, Vict., × 1.
Fig. 46—*Columbarium acanthostephes vulsum* subsp. nov., P26475, holotype, × 1.
Fig. 47—*Columbarium acanthostephes acanthostephes* (Tate), P26449, hypotype, Fossil Beach, Vict., × 1.
Fig. 48—*Columbarium cochleatum* (Tate), SA P6495, hypotype, Aldinga, × 1½.
Fig. 49—*Columbarium acanthostephes acanthostephes* (Tate), T 474A, holotype, Fossil Beach, Vict., × 1.
Fig. 50—*Columbarium cochleatum* (Tate), SA P6495, hypotype, × 1½.
Fig. 51—*Columbarium acanthostephes acanthostephes* (Tate), P26449, hypotype, × 1.
Fig. 52—*Columbarium spinulatum* Cossmann, P26473, hypotype, R. Murray 4 miles below Morgan, S.A., × 1.
Fig. 53—*Columbarium acanthostephes echinatum* subsp. nov., P26468, holotype, Fossil Bluff, Tas., × 1.
Fig. 54-55—*Columbarium spinulatum* Cossmann, P26472, hypotype, R. Murray 4 miles below Morgan, S.A., × 1.
Fig. 56—*Columbarium acanthostephes echinatum* subsp. nov., P26468, holotype, × 1.
Fig. 57—*Columbarium spinulatum* Cossmann, P26473, hypotype, × 1.

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Fig. 58—*Columbarium distephanotis* Melvill, MM EE 3651, holotype, Torres Strait, × 3.
Fig. 59—*Columbarium spinicinctum* (Martens), AM C64800, holotype of *C. caragarang* Garrard, off Cape Morton, Qld., × 1.
Fig. 60—*Columbarium natalense* Tomlin, SAM A3497, holotype, off Cape Natal, South Africa, × 1.
Fig. 61-62—*Columbarium veridicum* Dell, M16274, holotype, off Poor Knights Is., N.Z., × ¾.
Fig. 63—*Columbarium spinicinctum* (Martens), AM C64800, holotype, of *C. caragarang* Garrard, × 1.
Fig. 64—*Columbarium distephanotis* Melvill, MM EE 3651, holotype, × 3.
Fig. 65—*Columbarium hedleyi* Iredale, AM C60675, holotype of *C. trabeatum* Iredale, off Sydney, N.S.W., × 2.
Fig. 66—*Columbarium spinicinctum* (Martens), NMVF 26251, hypotype, off Cape Moreton, Qld., × 1.
Fig. 67—*Columbarium formosissimum* Tomlin, SAM A3500, paratype, off Cape St Blaize, S. Africa, × 1.
Fig. 68—*Columbarium spinicinctum* (Martens), NMVF 26251, hypotype, × 1.
Fig. 69—*Columbarium hedleyi* Iredale, AM C67025, holotype, off Sydney, N.S.W., × 1.
Fig. 70—*Columbarium hedleyi*, AM C60675, holotype of *C. trabeatum* Iredale, × 2.
Fig. 71—*Columbarium hedleyi*, AM C67025, holotype, × 1.
Fig. 72—*Columbarium hedleyi*, NMV F27079, hypotype, off Botany Bay, N.S.W., × 1.
Fig. 73—*Columbarium* (?) *vulneratum* (Finlay and Marwick), AIM TM/329, holotype, Boulder Hill, N.Z., × 1½.
Fig. 74—*Columbarium pagodoides* (Watson), BM(NH) 1887.2.9.688, lectotype, off Sydney, N.S.W., × 1½.
Fig. 75—*Columbarium formosissimum* Tomlin, SAM A3500, paratype, × 1.
Fig. 76—*Columbarium pagodoides* (Watson), BM(NH) 1887.2.9.688, lectotype, × 1½.
Fig. 77—*Columbarium* (?) *vulneratum* (Finlay and Marwick), AIM TM/329, holotype, × 1½.
Fig. 78—*Columbarium hedleyi* Iredale, NMV F27079, hypotype, × 1.

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Fig. 79—*Serratifusus clydoniatus* sp. nov., P26491, holotype, Murgheboluc, Vict., × 1.
Fig. 80—*Serratifusus squamulatus* sp. nov., P26503, holotype, Manyung Rocks, Vict., × 1.
Fig. 81—*Serratifusus squamulatus* sp. nov., P26505, paratype, Manyung Rocks, Vict., × 1.
Fig. 82—*Serratifusus stellatus* sp. nov., P26499, holotype, Grices Creek, Vict., × 1.
Fig. 83—*Serratifusus squamulatus* sp. nov., P26505, paratype, × 1.
Fig. 84—*Serratifusus scabrosus* sp. nov., P26481, paratype, Fischers Point, Vict., × 1.
Fig. 85—*Serratifusus foliaceus* (Tate), P26489, hypotype, Fossil Beach, Vict., × 1.
Fig. 86—*Serratifusus stellatus* sp. nov., P26499, holotype, × 1.
Fig. 87—*Serratifusus clydoniatus* sp. nov., P26494, paratype, Murgheboluc 2B, Vict., × 1.
Fig. 88-89—*Serratifusus* (?) *youngi* (Chapman), P13246, holotype, Curlewis, Vict., × 2.
Fig. 90—*Serratifusus clydoniatus* sp. nov., P26491, holotype, × 1.
Fig. 91—*Serratifusus squamulatus* sp. nov., P26503, holotype, × 1.
Fig. 92—*Serratifusus foliaceus* (Tate), P26489, hypotype, × 1.
Fig. 93—*Serratifusus stellatus* sp. nov., P26501, paratype, Grices Creek, Vict., × 1.
Fig. 94-95—*Serratifusus archimedes* sp. nov., P26497, paratype, Grices Creek, Vict., × 1.
Fig. 96-97—*Serratifusus archimedes* sp. nov., P26496, holotype, Grices Creek, Vict., × 1.
Fig. 98—*Serratifusus foliaceus* (Tate), T 486A, holotype, Muddy Creek, Vict., × 1.
Fig. 99—*Serratifusus clydoniatus* sp. nov., P26492, paratype, Murgheboluc 4a, Vict., × 1.
Fig. 100—*Serratifusus scabrosus* sp. nov. (?), P26483, figured specimen, Fossil Bluff, Tas., × 1.
Fig. 101—*Serratifusus scabrosus* sp. nov., P26480, holotype, Fischers Point, Vict., × 1.
Fig. 102—*Serratifusus craspedotus* (Tate), P26487, hypotype, Fossil Beach, Vict., × 1.
Fig. 103—*Serratifusus craspedotus* (Tate), T 466A, holotype, Muddy Creek, Vict., × 1.
Fig. 104—*Serratifusus craspedotus* (Tate), P26487, hypotype, × 1.
Fig. 105—*Serratifusus scabrosus* sp. nov., P26480, holotype, × 1.

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Fig. 106—*Coluzea cingulata* (Martens), IZMHUB 61029, holotype, Pemba Channel, E. Africa, × 1.
Fig. 107—*Fulgurofusus sarissophorus* (Watson), BM(NH) 1887.2.9.687, holotype, off Pernambuco, Brazil, × 1½.
Fig. 108—*Histricosceptrum canaliculatum* (Martens), IZMHUB 61028, holotype, off Zanzibar, E. Africa, × 1⅔.
Fig. 109-110—*Coluzea radialis* (Watson), SAM A4617, hypotype, off the Cape of Good Hope, S. Africa, × 1.
Fig. 111—*Histricosceptrum canaliculatum* (Martens), IZMHUB 61028, holotype, × 1⅔.
Fig. 112—*Fulgurofusus sarissophorus* (Watson), BM(NH) 1887.2.9.687, holotype, × 1½.
Fig. 113—*Fulgurofusus brayi* (Clench), MCZ 221602, paratype, off Cabo Codera, Venezuela, × 1½.
Fig. 114—*Fulgurofusus* sp., NZOI E749/TAM, figured specimen, off Castle Point, New Zealand, × 1.
Fig. 115—*Fulgurofusus brayi* (Clench), MCZ 221602, paratype, × 1½.
Fig. 116—*Coluzea cingulata* (Martens), IZMHUB 61029, holotype, × 1.
Fig. 117—*Coluzea radialis* (Watson), BM(NH) 1887.2.9.686, holotype, off the Cape of Good Hope, S. Africa, × 1.
Fig. 118—*Fulgurofusus benthocallis* (Melvill and Standen), RSM 1921.14.3.673, holotype, off South Orkney Islands, × 1.
Fig. 119—*Histricosceptrum atlantis* (Clench and Aguayo), MCZ 135170, hypotype, off Matanzas, Cuba, × 2.
Fig. 120-121—*Fulgurofusus bermudezi* (Clench and Aguayo), MCZ 135008, paratype, off Sagua la Grande, Cuba, × 2.
Fig. 122—*Histricosceptrum atlantis* (Clench and Aguayo), MCZ 135170, hypotype, × 2.
Fig. 123—*Coluzea radialis* (Watson), BM(NH) 1887.2.9.686, holotype, × 1.
Fig. 124—*Fulgurofusus benthocallis* (Melvill and Standen), RSM 1921.143.673 holotype, × 1.
Fig. 125—*Coluzea angularis* (Barnard), SAM A4608, holotype, off Cape Point, S. Africa, × 1.
Fig. 126—*Coluzea rotunda* (Barnard), SAM A4592, holotype, off Cape Point, S. Africa, × 1.
Fig. 127—*Coluzea angularis* (Barnard), BM(NH) 1962.285, paratype, off Cape Point, S. Africa, × 1.
Fig. 128—*Fulgurofusus bermudezi* (Clench and Aguayo), MCZ 135169, hypotype, off Punta Alegre, Cuba, × 2.
Fig. 129—*Coluzea angularis* (Barnard), BM(NH) 1962.285, paratype, × 1.
Fig. 130—*Coluzea rotunda* (Barnard), SAM A4592, holotype, × 1.
Fig. 131—*Coluzea angularis* (Barnard), SAM A4608, holotype, × 1.

Addendum 1

Since the above was written further collecting in the Princetown-Port Campbell area has added to our knowledge of the distribution of several species present in the Gellibrand clay. Three distinct assemblages have been distinguished ranging from Batesfordian to Bairnsdalian. The localities and the columbariids found to date are as follow.

BATESFORDIAN: Cutting on Bornong Rd (= Steens Rd), top of hill 1·3 miles N. of Cooriemungle Rd, Grid Ref. Princetown A 982,485.

Serratifusus bovarius sp. nov.
Hispidofusus piscatorius sp. nov.
Columbarium acanthostephes echinatum sp. nov. with posteriorly directed keel spikes.

Cutting on Great Ocean Road ½ mile N. of Princetown, Grid Ref. Princetown B 053,286.

Serratifusus bovarius sp. nov.

BALCOMBIAN: Cliff section 2·1 miles NW. of Point Ronald, Grid Ref. Princetown B 027,2915.

Columbarium acanthostephes acanthostephes (Tate)
Hispidofusus senticosus (Tate)
Serratifusus foliaceus (Tate)
Serratifusus craspedotus (Tate)

Cliff section SE. end of Gibson Beach, Grid Ref. Princetown B 025,295.

Columbarium acanthostephes acanthostephes (Tate)
Serratifusus foliaceus (Tate)
Hispidofusus senticosus (Tate)

Cutting on Cooriemungle Rd, immediately S. of junction with Guy's Rd, Grid Ref. Princetown A 038,473.

Serratifusus craspedotus (Tate)
Serratifusus foliaceus (Tate)

Cutting on bend in Waare Rd opposite old house N. of Waare, Grid Ref. Princetown A 948,412.

Serratifusus foliaceus (Tate)
Serratifusus craspedotus (Tate)
Hispidofusus sp.

Cutting on Great Ocean Rd 1¼ miles NE. of Princetown, Grid Ref. Princetown B 063_5,297.

Serratifusus foliaceus (Tate)
Hispidofusus sp.

BAIRNSDALIAN: Cliff section NW. end of Gibson Beach, Grid Ref. Princetown B 022,298.

Columbarium acanthostephes vulsum sp. nov.
Hispidofusus senticosus (Tate)
Serratifusus stellatus sp. nov.

Clay immediately beneath limestone in cutting on track to V. A. L. quarry, Curdies, Panmure 871,589.

Columbarium acanthostephes vulsum sp. nov.
Serratifusus stellatus sp. nov.
Serratifusus squamulatus sp. nov.

Addendum 2

Whilst this paper was at the proof stage Mr P. A. Maxwell, New Zealand Geological Survey, Christchurch sent the author a photograph of a columbariid collected by him and the author at Hampden Beach, N.E. Otago, New Zealand, from strata of Bortomian (Middle Eocene) age. This species seems to be a *Columbarium*, in shape somewhat like *Fulgurofusus brayi* but axially and spirally sculptured as in *Columbarium heberti*.

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